

Volume XLIV—No. 16
APRIL 20, 1918

STATE AND COUNTY ROAD NUMBER

Subscription, \$3.00 a Year
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Gen. Goethals on Highway Improvements

"I am heartily in accord with a policy which will permit highway commissioners of the various States so to plan their work that they will be able to undertake the construction of new highways and of maintaining the existing ones so as to relieve railroad congestion."

Build Permanent Highways and Save Upkeep

IT is not enough to rush road building to relieve shipping congestion, but the highways must be so built as to eliminate maintenance as far as possible.

Labor is so scarce that it should not be used for repairing roads.

The concrete road is permanent and requires practically no maintenance. Kahn Highway Products insure the best construction for concrete roads, for reinforcing, for permanent joints and for protecting concrete curbs.

Write to-day for Highway Pamphlet and Estimates.



TRUSCON STEEL COMPANY (Trussed Concrete Steel Company)

Representatives in Principal Cities

YOUNGSTOWN, OHIO

Warehouses in Boston, Chicago, Detroit, Moline, Philadelphia, Portland, Ore.

Kahn Road Mesh

Large flat sheets easily handled—no unrolling of coils nor cutting to length. The most efficient reinforcement for concrete roads and pavements.



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Kahn Armor Plates

Perfectly protect expansion joints. The split end prongs assure positive anchorage in the concrete, and plates are correctly placed by our improved Installing Device.



Kahn Curb Bars

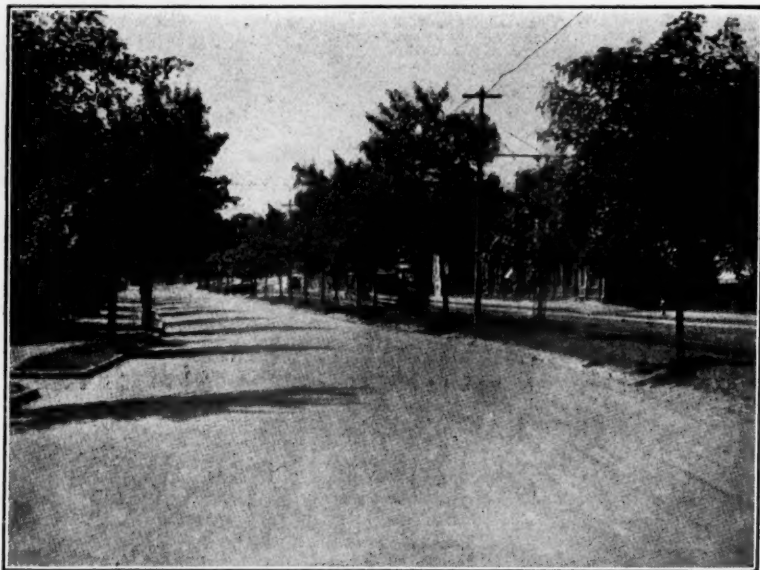
Protect and reinforce concrete curbs. Strong, rigid, convenient, easy to install. Furnished straight or curved.



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WE SELL SERVICE

Conscientious, honest service should be of vast importance in regard to laying plans for pavement contracts.



Bitulithic Pavement, Columbia Road, Dorchester, Mass. Laid over old macadam.

Bitulithic

is a pavement of merit which is the foundation for its phenomenal success.

In the past 16 years BITULITHIC has been adopted in over 425 cities as a standard construction for their streets and has been laid and contracted for to the extent of over 52,000,000 square yards which is equivalent to over 2,900 miles of roadway 30 feet wide between curbs.

THE TWO PRINCIPAL FACTORS SERVICE and QUALITY

Everyone should encourage the building of highway systems—which systems should be paved with a construction that will stand the fast moving motor truck traffic.

Highway Systems for Transportation are WAR ESSENTIALS

Specify BITULITHIC

the pavement which has stood the test and has proven that it is worth much more than other bituminous constructions. BITULITHIC saves greatly in maintenance expense over the inferior types of construction which require constant expense for their upkeep.

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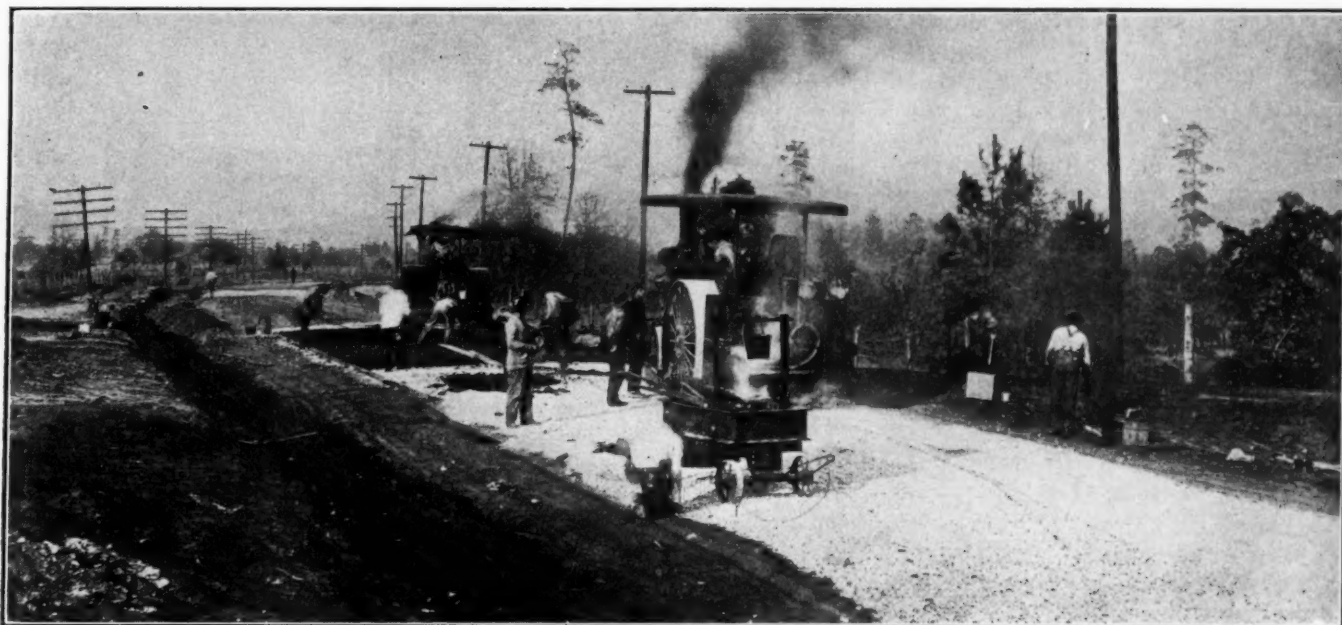
Volume XLIV.

NEW YORK, APRIL 20, 1918

No. 16

A LOUISIANA ROAD FOR WAR-TIME TRAFFIC

Connecting Alexandria and Camp Beauregard—Five Per Cent Limiting Grade Necessitates Considerable Grading—Warrenite Laid on Broken Stone Base—Mixtures Used—Eliminating Grade Crossings—Difficult Pier Construction.



CONSTRUCTION WORK ON ROAD TO CAMP BEAUREGARD.

The parish, the state and two departments of the government—War and Agriculture—are cooperating in the construction of a road between Alexandria, La., and Camp Beauregard, the National Guard Cantonment near that city. Though constructed primarily for carrying the heavy war traffic between Alexandria and the camp, the road will also be a link in the main highway, construction of which is contemplated, between Camp Pike, near Little Rock, Ark., and Camp Beauregard. The section now under construction is to be about 4 miles long, and the paved portion 20 feet wide. The total cost will reach about \$135,000.

In designing the road, long-radius curves and a grade limit of 5 per cent were adopted. Due to the rolling character of the country, this latter requirement made necessary considerable grading. This work, which involved the moving of about 60,000 cubic yards of earth, was done by force account. Wheel and drag scrapers were used almost entirely, the average haul being under 300 feet, though in one or two places it was necessary to carry 500 feet. The maximum cut was 18 feet and the heaviest fill 25 feet. On the whole, cuts and fills balanced well and little earth had to be wasted. About 60 teams were employed on grading. The cost was approximately 40 cents per cubic yard. The general demoralization of

labor, due to nearby military camp construction and consequent high prices, was a factor in this cost.

The base, surface, shoulders, ditches and culverts were all constructed by contract by A. R. Young & Company, Topeka, Kans. A base of crushed stone, compacted to a thickness of 6 inches, was specified, partly for reasons of economy and partly because of difficulty in getting other materials than a rather poor quality of stone and sand. The stone was shipped by rail from Winnfield, about 40 miles distant. It is a rather soft and friable limestone, unsuitable for use where exposed to the impact of traffic, but of good quality for a base and easily compacted into a firm foundation:

The stone is unloaded by hand from the cars into bins, whence it is discharged by gravity into 2-yard Troy dump wagons, which are hauled by four mules. It is spread on the subgrade in two layers, each about four inches thick. These are rolled separately and compacted into a mass having a total thickness of 6 inches.

On the base thus prepared is spread a layer of Warrenite which, when compacted, averages slightly over 2 inches in thickness (specifications call for an even 2 inches). This is rolled thoroughly, both longitudinally and transversely, with 10-ton rollers, of which there are two in use—Buffalo-Pitts and Case. On top of the sur-



SECTION OF COMPLETED ROAD.

face already rolled is placed a seal coat about $\frac{1}{4}$ inch in thickness. This also is rolled.

A Warren portable asphalt plant is used to mix the materials. This plant has a capacity of about 1,000 yards of surface per 10-hour day. The "hot stuff" is hauled from this plant, which is located about midway of the section being built, in 2-yard, 4-mule wagons and dumped directly onto the foundation, whence it is moved into place by rakes, shovels and hoes, especial care being taken to move every particle of material. Troy wagons are used, and these, with four mules, driven by a man riding one of them, average about $2\frac{1}{2}$ miles an hour.

The mixture used for the wearing coat is approximately as follows:

| | Pounds. |
|---------------------------|---------|
| Clean washed gravel..... | 1,880 |
| Sand | 400 |
| Rock dust | 350 |
| Bituminous material | 155 |

The gravel used varies from $\frac{1}{4}$ to $1\frac{1}{4}$ inches in size. It is local material and of good quality. The bituminous material is either Bermudez or Standard No. 9.

For the seal coat the mixture is about:

| | Pounds. |
|---------------------------|---------|
| Clean sand | 2,375 |
| Bituminous material | 290 |

In addition to the heavy grading work, the cost of the road was further increased by the desire to eliminate all grade crossings. In one place, the road passes under the tracks of the Louisiana Railway & Navigation Company, while at another it is carried over the tracks of the Louisiana & Arkansas.

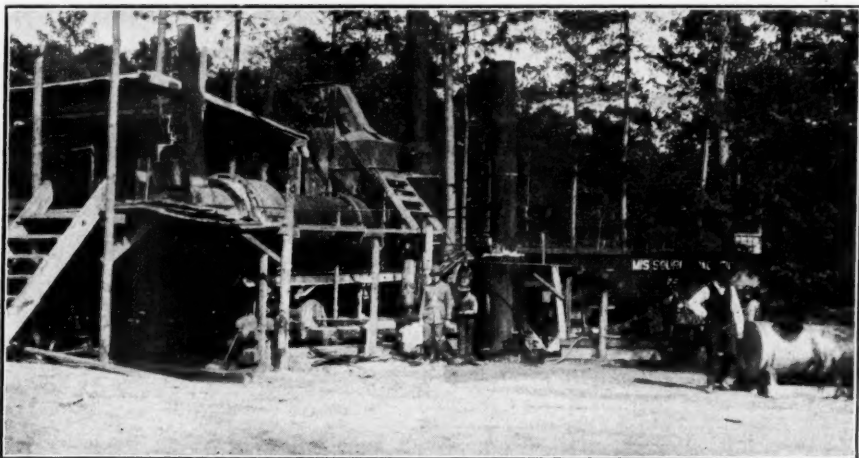
At the overhead crossing, the work was comparatively simple, a wooden bridge being built to carry the road traffic. Long fills were constructed at either end of the bridge to maintain the grade within the 5 per cent limits.

At the under pass, a two-span concrete viaduct was built to carry the railroad, which crosses the road at a skew. Owing to the limited headroom, it was necessary to place one of the piers in the center of the road, which was slightly widened at this point.

Considerable difficulty was encountered in securing suitable foundations for this concrete girder bridge. Just below the surface, quicksand was found, and though excavation was carried down ten or twelve feet no firm material was reached. Finally the difficulty was met by spreading the bases of the abutments and of the central pier, thus reducing the unit pressure to a minimum. It was necessary to carry the central pier somewhat lower than the others, though this depth did not exceed about ten feet.

Gutters had to be carried along both sides of the road under the viaduct and these had to be designed to carry

considerable water. It was feared that, in excavating them, the support of the road foundation would be withdrawn, causing collapse. To protect the earth and sand underneath the road—and the abutments and pier as well—piling was driven parallel to and near the edge of the road, leaving a space about three feet wide between the piling and the abutment piers. The purpose of this piling is to act as a cofferdam, retaining the supporting material under the road, while allowing the excavation of a deep gutter between the road and the abutments. After the piling had been placed, the sand was excavated for a depth of about 30 inches along the gutter location and a concrete floor 8 inches thick was laid to prevent scouring by water. About 100 feet of piling was necessary to protect the road at this point. Tongue-and-



PORTABLE PLANT USED FOR MIXING "HOT STUFF."

groove pine $2\frac{1}{2}$ inches thick was used. This was driven to a depth of 5 feet by a 1,600-pound drop hammer. About 18 to 20 blows were required to sink the piles to the proper depth.

In constructing the bridge, the concrete was placed from a small tower just south of the road and along the railroad track. The concrete was mixed 1:1:3. A Chain-Belt mixer was used for all concrete work.

All culverts are of concrete, reinforced. The contract price for concrete work was \$17.50 per cubic yard. The gravel shoulders, which extend three feet on each side of the road, cost \$2.80 per cubic yard in place.

L. T. Gilmer is engineer in charge of the work; he also supervised the grading work, most of which was done last fall. Lester Valliant is superintendent for the contractors.

FOR A PERMANENT TRAFFIC POLICY.

The Chamber of Commerce of the United States met in Chicago last week and passed a number of resolutions bearing upon the conditions brought about by the war and the necessities originating with them. Among these it included the matter of transportation, urging the government to use to the utmost possible extent not only the railroads, but also inland and coast-wise waterways and highways, considering it to be essential that highways for heavy traffic be completed where they can be used in relieving railroad congestion. It recommended the adoption of a permanent policy assuring coordination of railroads, waterways and highways for traffic service.

Similar Resolutions were adopted April 16th by the Highway Traffic Association of New York State, which resolutions will be found on another page of this issue.

ROAD WORK DURING 1918

Amounts That the Highway Authorities of the Several States Expect to Lay During the Present Year—How the Funds Will Be Raised—Effect of War Conditions on Road Program.

The amount of money that the state highway officials expect will be used in the several states for road work during the present year is reported to be nearly three hundred million dollars. Whether or not all of this, or how much of it, will actually be spent will depend largely upon the ability of the several states and counties to obtain the material and labor. Apparently no difficulty is anticipated by any of them in obtaining funds for all the work that can be constructed.

A few weeks ago a large business corporation interested in the paving business gathered data from all of the states, on which it based an estimate of the amount which would probably be spent by each of them this year. During the past month Municipal Journal has obtained similar information, which appears to indicate that a number of the states recently have increased their estimates of the amount of work that will be done, while a few of them are of the opinion that conditions may reduce the amount which it is practicable to do, even though the funds for much more will be available.

The largest amount reported by any state is \$25,000,000, the estimate of Texas. Julian Montgomery, chief office engineer of the State Highway Department, informs us that this amount will be spent, "contingent on the war

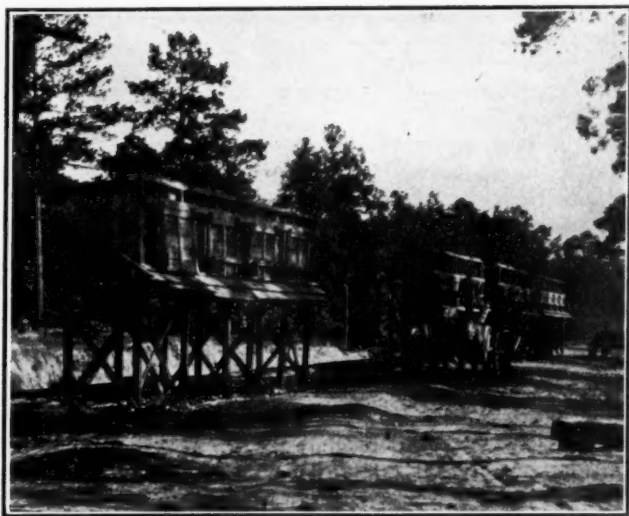
will provide about \$12,842,000, of which 40 per cent will go into improvements and 60 per cent into maintenance. The above also includes bridges, for which about \$600,000 will be required.

Next in order come West Virginia, with \$14,000,000; California, with \$12,000,000; Minnesota, with \$11,500,000; Pennsylvania, with \$11,000,000; Kansas, with \$10,500,000; Wisconsin, with \$10,125,000. Concerning the Minnesota estimate, Charles M. Babcock, commissioner of highways of Minnesota, writes that, of the \$11,500,000 that he expects will be spent this year in that state, \$853,047 will be federal aid, \$2,220,000 will be state aid, \$4,627,676 will be county road and bridge funds, and the remainder will be township funds. Of this amount, practically all except the township funds are expended under the direction of the Highway Department.

Concerning Pennsylvania's estimate, George H. Biles, acting chief engineer of the State Highway Department, states that of the \$11,000,000 that he expects will be spent in that state, \$1,382,000 is from federal aid, \$7,025,500 will be provided by the state, and \$3,000,000 by counties or other districts.

In Kansas \$10,500,000 is available, of which W. S. Gearhart, state highway engineer, writes that he thinks about \$4,000,000 will be spent, of which \$625,000 will be federal aid, \$25,000 will be for state administration, and \$3,275,000 will be provided by counties or other districts.

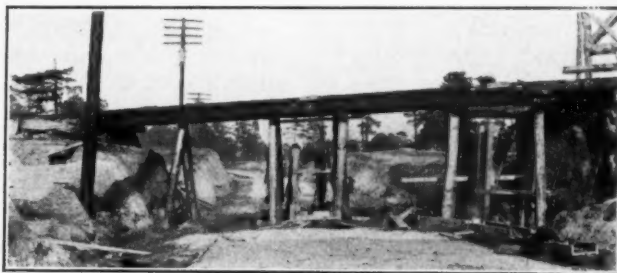
Concerning the expected expenditure of \$15,000,000 by Arkansas, William B. Owen, chairman of the State Highway Commission, states that there are at the present time more than 22,000 miles of the various types of roads under construction, or with construction provided for, at a cost of more than \$12,000,000. In addition there are numerous improvement districts in course of formation which he is sure will go through which will spend



BINS THAT RECEIVE STONE FROM CARS AND LOAD WAGONS BY GRAVITY.

situation." Of this amount, \$1,753,973 will come from the federal aid fund, \$1,000,000 will be provided by the state, and the balance, or \$22,246,027, will be provided by counties or other districts.

The next in order are Indiana, with a proposed expenditure of \$17,380,000; Illinois, with \$17,000,000; Massachusetts, with \$15,637,000; Iowa, \$15,500,000, and Arkansas, \$15,000,000. Concerning the Massachusetts estimate, William D. Sohler, chairman of the State Highway Commission, writes: "This year the total expenditure will be about \$15,637,000, of which \$7,624,889 will be for construction and reconstruction, and \$8,012,333 will be spent for maintenance, oiling, etc. Of this amount, the state will provide \$2,795,000." It is probable that \$85,000 will be obtained from the federal aid fund, although approval may be secured of projects involving \$300,000 to \$400,000 of federal aid. The cities and towns



OLD RAILROAD CROSSING BEING REPLACED WITH CONCRETE STRUCTURE.



OVERHEAD CROSSING TO REPLACE OLD GRADE CROSSING, SHOWN IN FOREGROUND.

more than \$3,000,000. The estimate of more than \$15,000,000 does not include improvements made by the counties, out of the 3-mill road tax, the expenditure of which is not under the supervision of the state department. As road districts are being continually formed, the above figures have to be supplemented almost daily. Probably the largest project in the whole country is one covering 168 miles of road to be constructed part of macadam, part of gravel, and 115 miles of asphalt concrete on a concrete basis at a cost of \$2,788,000, the contract for which has already been let. Besides the federal aid of \$650,000, an equal amount will be provided by the state from the auto license tax, while the balance will be derived from bonds raised by the improvement districts.

Tennessee is reported by the secretary of the State Highway Department to anticipate spending \$10,000,000, of which \$600,000 will come from federal aid, \$1,200,000 will be provided by the state, and the balance by counties and other districts. This includes the cost of bridges to be built, as well as roads.

New York may spend about \$8,500,000. I. J. Morris, secretary of the State Highway Commission, writes: "We have in force construction contracts, the amount of work remaining to be done under which aggregates about \$7,000,000. Of this, approximately three-fourths is paid by the state and one-fourth by the counties. Present indications, based on the experience of last year, are that labor and material will be available to perform about \$4,500,000 worth of this work. We do not anticipate that it will be possible to get it all done. In addition to this, we have nearly \$4,000,000 available for maintenance and repair of improved roads by state funds. This we expect will probably be expended. None of the moneys to be expended this year come from federal aid."

James Allen, highway commissioner, says that \$7,216,000 is the estimate of the State of Washington, but this does not include amounts that may be expended from bond issues, the amount of which cannot be estimated. Of the above sum, \$216,000 is federal aid, \$2,500,000 will be provided by the state, and \$4,500,000 by counties and other districts.

Concerning Ohio H. L. Hastings, chief clerk of the State Highway Department, gives as the estimate of this year's expenditure \$7,210,000, of which \$1,120,000 is federal aid, \$4,090,000 will be provided by the state, and \$2,000,000 by the counties and other districts.

New Jersey is reported by A. Lee Grover, secretary of the State Highway Commission, as anticipating spending \$8,000,000 this year. This is nearly double last year's expenditures, the large advance being due to the new State Highway system, which is financed under a 1-mill tax that yields \$3,000,000. This total of \$8,000,000 is in addition to a considerable amount that will probably be spent entirely from county funds; \$118,425 of the total is federal aid, \$5,500,000 will be provided by the state, and \$2,500,000 will be provided by the counties.

Oklahoma expects to spend \$6,000,000, of which \$475,000 will be from federal aid, \$1,475,000 provided by the state, and the balance by the counties or other districts.

Oregon expects to spend \$5,652,516, of which G. E. Ross, secretary of the State Highway Commission, informs us that \$855,506 will be from federal aid, and the balance will be provided by the state. Louisiana, \$5,300,000; Kentucky, \$4,500,000; Georgia, \$4,300,000; Missouri, \$4,000,000; Colorado, \$3,635,000.

G. P. Coleman, state highway commissioner of Virginia, says that at the date of writing, March 22d, they had in view approximately \$2,500,000, exclusive of maintenance, and \$1,100,000 for the latter. Neither of these include ordinary county road construction, which does

not come under this department. Of the \$2,500,000 for construction, \$600,000 will be from federal aid, \$1,400,000 provided by the state, and \$500,000 by the counties or other districts.

Mississippi expects to spend \$3,500,000; North Dakota, \$3,500,000. Concerning Maine, chief engineer Paul D. Sargent reports that on state highways, federal aid roads and state aid roads they expect to spend \$1,517,000, of which \$275,000 will be provided by federal aid, \$924,000 given by the state, and \$300,000 by the counties and towns. Besides this, they expect to spend \$500,000 on maintenance of state and state aid roads, of which about \$150,000 will come from the cities and towns, the remainder being supplied by the State Highway Commission from automobile license fees. The cities and towns will probably provide about \$1,200,000 for ordinary maintenance and some construction work outside of the state aid roads. This gives a total of about \$3,217,000.

Concerning Arizona, T. F. Nichols, the office engineer of the State Highway Department, reports that they expect to spend \$3,000,000, of which \$200,000 will be from federal aid, \$900,000 provided by the state, and \$1,900,000 by counties or other districts.

Montana expects to spend \$3,000,000, of which about \$150,000 will be from federal aid, and all of the balance will be furnished by the counties. The State Highway Department will furnish only the cost of engineering on federal aid projects. Florida, \$2,750,000; Maryland, \$2,700,000; Alabama, \$2,500,000. Connecticut reports through C. G. Nichols, chief clerk of the Highway Commission, that the legislature made appropriations for the two years ending September 30, 1919, as follows:

| | |
|--|-------------|
| For construction | \$2,500,000 |
| For maintenance and reconstruction..... | 1,350,000 |
| For elimination of dangerous conditions on trunk lines | 75,000 |
| For bridges, construction and maintenance... | 980,000 |
| For maintenance of two toll-bridges and three ferries | 50,000 |
| For administration, including engineering expenses | 253,000 |

The commission has one contract under federal aid for a total of \$134,054, of which the United States Government will contribute about \$53,000. On construction work, towns contribute one-fourth or one-eighth on state aid roads, depending upon the amount of assessed valuations of the towns in which the work is done. On repairs and maintenance of state aid roads, the towns refund one-fourth. Counties have no part in road work in Connecticut.

North Carolina expects to spend \$2,500,000, of which \$684,000 is from federal aid. Michigan, writes State Highway Commissioner Frank F. Rogers, has available \$872,000 of federal aid funds, for the three years of 1917, 1918 and 1919, which represents a total expenditure of about \$2,000,000. All of this will not be spent this year, but a considerable part of the contracts will probably extend over into 1919. This federal aid work will cover about 180 miles of road. In addition to this, the state proposes to build about 170 miles of special assessment roads under the act of the 1915 legislature. Complete returns have not been received from counties and townships, but the State Highway Department is emphasizing the importance of concentrating work on through roads and using local materials, shipping in materials only for very important roads; this being done in order to relieve railroad transportation.

Gov. W. E. Lindsey of New Mexico writes that his state expects to spend \$1,621,000 up to June 30, 1919, of which \$303,000 is federal aid, \$137,000 is county aid, \$440,000 is state aid to offset these two items; \$481,000

is by counties direct, in addition to \$54,000 auto revenues to the counties; \$133,000 is forest aid, \$2,000 is state road fund, \$17,000 is from state highway bonds, and \$54,000 is state auto revenues.

South Carolina expects to spend \$1,498,000; Nebraska, \$1,279,757; Utah, \$1,131,754; Delaware, \$1,000,000; Wyoming, \$806,000; Vermont, \$685,000; Rhode Island, \$600,000. New Hampshire will have \$1,075,600 available for this year and next, of which \$125,600 is from federal aid, \$50,000 will be provided by the state, and \$400,000 by counties or other districts.

Nevada expects to spend \$506,000; South Dakota, \$300,000, of which \$100,000 will be federal aid, \$50,000 will be provided by the state, and \$150,000 by counties or other districts.

EFFECT OF WAR CONDITIONS.

The highway commissioners were asked: "Is your road program curtailed by any condition caused by the war and if so in what way?" The more important replies received to this question were as follows:

Commissioner Babcock of Minnesota says: "Our road program has not been curtailed by any condition caused by the war, except that it has been placed on a more efficient and substantial basis. Our activities this

year and during the period of the war will be confined to only the substantial improvement of main lines of travel and to intensive maintenance of the general road system."

Col. Sohler, of Massachusetts: "The war has affected us a great deal. The state will cut down its construction expenditures for highways about \$2,000,000. It will confine all its work to the main through routes, filling in the weaker places and trying to maintain the older roads. As far as possible we shall use local materials combined with bitumen. The war has about doubled our costs over those of a few years ago."

George H. Biles, of Pennsylvania: "Practically all the work under contract and proposed for construction by this department during the present year is contingent upon the orders issued by the Director General of Railroads covering the use of railroad cars for the shipment of road building materials."

W. S. Gearhart, of Kansas: "It is now evident that a considerable part of it (the amount available) can not not be finished on account of the labor shortage and the inability to get materials."

In Arkansas, Chairman Owen writes, the program is curtailed by labor shortage and difficulty in transporting

(Continued on page 324.)

COUNTY HIGHWAY WORK PERFORMED DURING 1917

Data Furnished Expressly for These Tables by County Highway Officials in All Sections of the Country—
Amount, Nature and Cost of Each Kind of Road Construction in Each County.

EARTH ROADS BUILT IN 1917.

| County & State. | Amount built miles or sq. yds. | Cost per mile or sq. yd. | Width of roadway graded. | Cost of grading per mile. | County & State. | Amount built miles or sq. yds. | Cost per mile or sq. yd. | Width of roadway graded. | Cost of grading per mile. |
|-----------------------|--------------------------------|--------------------------|--------------------------|---------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|---------------------------|
| Arizona: | | | | | Iowa (Continued). | | | | |
| Greenlee | 140,000 | \$995 | 18 | \$600 | Osceola | 3.5* | 0.27 | 24-26 | ... |
| California: | | | | | Tama | 6* | 1,600a | 26 | 1,600 |
| San Louis Obispo..... | 40† | 150 | 16-20 | ... | Webster | 7†† | 1,300 | ... | ... |
| Colorado: | | | | | Kansas: | | | | |
| Morgan | 50 | 32-50 | 30 | ... | Logan | 65† | 35a | 25 | 35 |
| Florida: | | | | | Kentucky: | | | | |
| Orange | 45*† | 200a | 30 | ... | Greenup | 30* | 2,100 | 22 | 2,100 |
| Georgia: | | | | | Nicholas | 9.75*† | ... | ... | ... |
| McIntosh | 29† | ... | 24-30 | ... | Trimble | 15 | 30a | 16 | 30 |
| Idaho: | | | | | Michigan: | | | | |
| Canyon | 60† | 175a | 28 | ... | Luce | 6* | 1,012 | 24 | ... |
| Cassia | 10 | 300b | 25 | 300 | Minnesota: | | | | |
| Lemhi | 22 | ... | 16-22 | ... | Anoka | 5* | ... | 24 | 1,250 |
| Power | 24 | 500 | 24 | 200 | Brown | 17* | ... | 24 | 840 |
| Illinois: | | | | | Cottonwood | 22* | 1,342 | 24 | 1,200 |
| Carroll | 5* | 3,000b | 24 | 2,000 | Goodhue | 10† | 0.32a | 24 | ... |
| Christian | 7.7 | 2,960c | 24 | ... | Isanti | 4† | 1,500 | 36 | ... |
| Clay | 1.1 | 6,000b | 24 | ... | Itasca | 20* | 2,500 | 20 | ... |
| Dupage | 2* | 4,000 | 30 | ... | Martin | 16† | ... | 24 | ... |
| Fulton | 5* | 2,200 | 24 | ... | Nicollet | 7.43* | 678a | 20-24 | 678 |
| Kane | 33† | 75-200 | 24 | ... | Redwood | 11* | 2,000-3,600 | 24 | ... |
| Lake | 15 | ... | ... | 500 | Roseau | 20 | ... | 24 | ... |
| Marshall | 4* | 3,232d | ... | ... | Todd | 15† | 900 | ... | ... |
| McDonough | 11* | 2,600b | 24 | 1,500 | Missouri: | | | | |
| Schuyler | 40† | ... | 28-34 | 200 | Camden | 100† | 200 | 24 | 60 |
| Stephenson | 30 | 50a | 30 | 50 | Miller | 100† | 170a | 16-24 | 170 |
| Washington | 4* | 2,000d | 24 | ... | Polk | 50 | 75 | 18 | ... |
| Iowa: | | | | | Douglas | 50† | 500a | 24 | 500 |
| Adams | 23† | 89a | 36 | 89 | Jasper | 47 | ... | ... | 130 |
| Appanoose | 30† | 36a | 36 | 36 | Lincoln | 54.5 | 283 | 25 | ... |
| Cedar | 3.9* | ... | 24-26 | 2,660 | Mississippi | 35* | 500 | 40 | 400 |
| Cerro Gordo | 25* | 1,400a | 24 | 1,400 | Ste. Genevieve | 100 | ... | ... | ... |
| Cherokee | 16.25* | 0.255a | 26 | ... | Washington | 30† | ... | 24 | 500 |
| Clayton | 9.5 | 750a | 26 | 750 | Montana: | | | | |
| Des Moines | 0.3 | 0.50 | ... | ... | Carbon | 73 | 350† | 18-30 | ... |
| Dickinson | 41* | 0.25a | 26 | ... | Gallatin | 25*† | ... | 24 | 500 |
| Fayette | 15 | ... | ... | ... | Granite | 15† | ... | 24 | 400 |
| Floyd | 12,149† | 0.356 | 26 | 96 | Madison | 55 | ... | 18 | 420 |
| Greene | 12 | ... | 24 | 772* | Nebraska: | | | | |
| Hancock | 6.08 | 8,338 | ... | ... | Keyapaha | 4* | 30 | 40 | ... |
| Harrison | 26.5† | 575a | 26 | 575 | New York: | | | | |
| Humboldt | 8.5 | ... | 36 | 1,300 | Schuyler | 150 | 50a | 26 | 50 |
| Ida | 3† | 2,500a | 18 | 2,500 | North Dakota: | | | | |
| Jasper | 12,000 | 0.28 | 28 | 1,750 | Divide | 38* | ... | 20 | 500 |
| Jefferson | 24† | 93a | 36 | 93 | Ohio: | | | | |
| Johnson | 8.5† | 1,500 | 26-36 | ... | Scioto | 10 | ... | ... | ... |
| Kossuth | 16.5* | ... | 26 | 1,110 | Oklahoma: | | | | |
| Lee | 41† | 105 | ... | ... | Craig | 20 | ... | ... | ... |
| Lyon | 2e | ... | 24-26 | 3,678 | Harper | 34 | ... | ... | 778 |
| Mahaska | 12 | 2,000a | 32 | 2,000 | Kingfisher | 20† | ... | 30 | 50 |
| Marshall | 6.6* | 22 | 26 | ... | Kiowa | 70 | ... | ... | 400 |
| Mills | 24† | 0.28 | 28 | ... | Major | 5 | ... | ... | ... |
| Mitchell | 25.5† | ... | 26 | 108 | Okmulgee | 36 | ... | 24 | 400 |
| Muscatine | 11.4* | 1,000-4,000a | 24 | ... | South Dakota: | | | | |
| O'Brien | 19* | 0.25 | ... | ... | Deuel | 90† | 1,000 | 36 | 37 |

EARTH ROADS BUILT IN 1917 (Continued).

| County & State. | Amount built miles or sq. yds. | Cost per mile or sq. yd. | Width of roadway graded. | Cost of grading per mile. |
|-----------------------|--------------------------------|--------------------------|--------------------------|---------------------------|
| Tennessee: | | | | |
| Lawrence | 15* | 1,200 | 21 | ... |
| Monroe | 40* | 1,500 | 18 | ... |
| Unicoi | 10.5 | 2,000 | 16-24 | 2,000 |
| Texas: | | | | |
| Taylor | 25† | 125 | 32 | ... |
| Vermont: | | | | |
| Windham | 5.75† | ... | 16-18 | 1,230 |
| Washington: | | | | |
| Adams | 8*† | ... | 24 | 1,776 |
| Columbia | 40 | ... | ... | ... |
| Douglas | 10*† | ... | 9-12 | 2,000 |
| Grant | 50† | ... | ... | 200 |
| Pend Oreille | 17.5 | 865 | 16 | ... |
| Pierce | 10 | 1,100 | 12-16 | ... |
| Snohomish | 5† | 2,500 | 20 | ... |
| Whitman | 5 | ... | ... | ... |
| West Virginia: | | | | |
| Barbour | 20 | 3,700 | ... | ... |
| Gilmer | 5 | ... | ... | ... |
| Grant | 60 | 90 | 16 | ... |
| Raleigh | 20* | 5,000a | 18-22 | 5,000 |
| Webster | 40 | 5,000 | 18 | 5,000 |
| Wisconsin: | | | | |
| Douglas | 37* | ... | 24 | 1,768 |
| Grant | 17 | 1,950a | 20 | 1,950 |
| Juneau | 2† | 0.14 | 20 | 300 |
| Monroe | 3† | ... | 20 | 987 |
| Polk | 15† | ... | 20 | 1,500 |
| Sauk | 7 | 900a | ... | 900 |
| Shawano | 11.5 | ... | 24-28 | 1,500 |
| Washburn | 14† | 1,400 | 26 | ... |
| Wyoming: | | | | |
| Platte | 15† | 30a | 24 | 30 |

*By contract. †By day labor. a—grading only. b—includes culverts. c—includes grading, oiling and bridges. d—includes bridges and culverts. e—to permanent grade; also 53.5 miles at natural grade at a cost of \$150 a mile. f—to permanent grade; also 61 miles of blade grading by contract at \$175 a mile.

OILING ROADS IN 1917.

| County and State. | Miles Oiled Last Year. | Amount of Oil Used. Gallons. | Cost per Mile |
|--------------------|------------------------|------------------------------|---------------|
| California. | | | |
| Alameda | 3 | 0.75* | \$1,000 |
| Santa Clara | † | 766 | ... |
| Illinois. | | | |
| Carroll | 30 | 150,000 | ... |
| Christian | 2 | 8,500 | 301 |
| Dupage | 9 | 26,000 | 600 |
| Fulton | 5 | 24,000 | 250 |
| Iroquois | 184 | 582,840 | ... |
| Lake | 20-25 | ... | ... |
| Marshall | 4.5 | 10,000 | 217 |
| McDonough | 47 | 175,000 | 390 |
| McHenry | 50 | 40,000 | 100 |
| Richland | 2 | 8,000 | 263 |
| Stephenson | 20 | 20,000 | 150 |
| Vermilion | 10 | 1 car | ... |
| Whiteside | 8 | ... | 200-400 |
| Indiana. | | | |
| Wayne | 12 | 36,000 | 150 |
| Iowa. | | | |
| Cedar | 40.8 | 150,000 | 174 |
| Des Moines | 2.75 | 9,887 | 366 |

OILING ROADS IN 1917 (Continued).

| County and State. | Miles Oiled Last Year. | Amount of Oil Used. Gallons. | Cost per Mile |
|--------------------------|------------------------|------------------------------|---------------|
| Iowa (Continued). | | | |
| Dickinson | 1.9 | 8,105 | 458 |
| Jasper | 25 | 130,000 | 200 |
| Jefferson | 3.75 | 16,000 | 325 |
| Lee | 12.5 | 5 cars | 305 |
| Muscatine | 5 | 12,787 | 140-240 |
| Tama | 0.75 | 0.5* | 340 |
| Maryland. | | | |
| Talbot | 18 | 27,000 | 450 |
| Montgomery | 13 | 35,000 | 690 |
| Michigan. | | | |
| Berrien | 101 | 210,000 | 340 |
| Van Buren | 16 | 0.5* | 28 |
| Missouri. | | | |
| Callaway | 0.6 | 3,365 | 560 |
| Clay | 10 | 3 cars | 400 |
| New Jersey. | | | |
| Burlington | 100 | 150,000 | ... |
| Gloucester | 19 | 65,000 | 421 |
| Mercer | 175 | 175,000 | 1,000 |
| Morris | 110 | 250,000 | 635 |
| Passaic | 76 | 139,084 | 146 |
| Somerset | 93.05 | 151,517‡ | 841‡ |
| New York. | | | |
| Cayuga | 35.44 | 53,000 | 336†† |
| Cortland | 6.45 | 14,603 | 595 |
| Franklin | 4.25 | 85,000 | 309 |
| Onondaga | 98 | 148,265 | 243† |
| Schuyler | 5.5 | 0.33* | 225 |
| Ulster | 25.82 | 0.25* | 523 |
| Washington | 2 | 6,000 | 300 |
| Ohio. | | | |
| Franklin | 44 | 142,415 | 922 |
| Highland | 114‡ | 398,494 | 560 |
| Huron | 4 | ... | ... |
| Sandusky | 10 | ... | ... |
| Shelby | 9 | 15,464 | ... |
| Oklahoma. | | | |
| Craig | 2 | 2.0* | ... |
| Okmulgee | 1 | 90 bbl. | 240 |
| Tennessee. | | | |
| Lawrence | 20,000** | 0.5* | 0.975* |
| Texas. | | | |
| Taylor | 4.5 | 0.5* | 600 |
| Vermont. | | | |
| Windham | 18 | ... | 204 |
| Washington. | | | |
| Garfield | 5 | 20,000 | 300 |
| Pierce | 6 | 15,000 | 600 |
| West Virginia: | | | |
| Barbour | 1 | 3* | 10,000 |
| Wisconsin. | | | |
| Adams | 2.5 | 0.5* | 175 |
| Douglas | 15 | 20,000 | 119 |
| Grant | 26 | 68,000 | 375 |
| Juneau | 22 | 40,000 | 140 |
| Kewaunee | 13 | 40,000 | 400 |
| Monroe | 44 | 118,352 | 238 |
| Outagamie | 19 | 50,000 | 325 |
| Ozaukee | 16 | 39,000 | ... |
| Rock | 20 | 7,000 | 360 |
| Sauk | 40.5 | 95,644 | 335 |
| Shawano | 3 | 17,000 | 200 |
| Walworth | 20 | 45,000 | 350 |

*Per square yard; †patching; ‡starvia; †includes stone chips used as "blotter"; **square yards; ††not including chips for "blotter."

BRICK PAVEMENT LAID IN 1917.

| County and State. | Amount built; miles or sq. yds. | Depth of cushion, inches. | Kind of filler. | Cost per mile or sq. yd. | Width of pavement, feet. | Width of roadway graded. | Cost of grading per mile. | Kind of base. | Thickness of base, inches. |
|-------------------|---------------------------------|---------------------------|-----------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------|----------------------------|
| California | | | | | | | | | |
| Santa Clara | 3,537* | monolith | grout | \$2.25 | 18 | 24 | \$1,989 | .... | 4 |
| Illinois | | | | | | | | | |
| Iroquois | 4.25 | ... | grout | 8,580a | 9 | 27 | .... | concrete | 1 |
| Peoria | 6,111* | monolith | grout | 2,04* | 18 | 28 | 1,577 | concrete | 4 |
| Stephenson | 5,333* | ... | ... | 20,185b | 16c | 30 | 1,500 | 1:3½ conc. | 4 |
| Vermilion | 17* | ... | ... | 12,500* | 10 | 50 | 800 | concrete | 4 |
| Whiteside | 1* | ¾ | grout | 16,500* | 16 | 32 | .... | macadam | 4-5 |
| Indiana | | | | | | | | | |
| Marion | 2.5* | monolith | ... | 1.87* | 30 & 39 | 50 | 0.35† | concrete | 5 |
| Iowa | | | | | | | | | |
| O'Brien | 10,000* | 1½ | asphalt | 2.31* | 56 | ... | ... | concrete | 4 |
| Polk | 2.5*† | monolith | grout | 2.63b | 20 | 36 | 5,000 | concrete | 4 |
| Michigan | | | | | | | | | |
| Berrien | 6,500 | ... | ... | 2.38 | 44 | 44 | .... | gravel | 8 |
| Calhoun | 10,000* | monolith | grout | 22,500 | 18 | 28 | .... | concrete | 4 |
| New Jersey | | | | | | | | | |
| Morris | { 3,134* | ... | ... | 1.70† | ... | ... | ... | 1:3:6 conc. | 6 |
| | { 4,562* | ... | ... | 1.50† | ... | ... | ... | | |
| | { 3,639* | ... | ... | 2.30† | ... | ... | ... | | |
| New York | | | | | | | | | |
| Chautauqua | 2.2* | 1½ | grout | 20,000 | 16 | 32 | 3,000 | concrete | 5 |
| Orleans | 21,000* | ... | ... | 1.35* | ... | ... | ... | concrete | 5 |
| Ulster | 16,000* | 1 | sand | ... | 16-53 | 24-53 | ... | concrete | 5 |
| Washington | 1.0* | ... | ... | ... | 30 | ... | ... | concrete | 6 |
| Ohio | | | | | | | | | |
| Coshocton | { 7,260* | 1 | tar | 2.00† | 16 | 26 | 1,000 | gravel | 9 |
| | { 0.5* | monolith | ... | 2.45† | 16 | 26 | 1,500 | gravel | 9 |
| Huron | 31,263* | monolith | grout | 1.91† | 16 | 30 | 1,700 | ... | 4 & 5½ |
| Madison | 4,545* | 2 | grout | 1.93† | 36 | 44 | 2,300 | concrete | 5 |
| Sandusky | 4.5* | 1½ | mastic | 30,000† | 16, 18 & 22 | 26-28 | 1,500 | concrete | 4 |

BRICK PAVEMENTS LAID IN 1917 (Continued).

| County and State. | Amount built; miles or sq. yds. | Depth of cushion, inches. | Kind of filler. | Cost per mile or sq. yd. | Width of pavement, feet. | Width of roadway graded, feet. | Cost of grading per mile. | Kind of base. | Thickness of base, inches. |
|-------------------|---------------------------------|---------------------------|-----------------|--------------------------|--------------------------|--------------------------------|---------------------------|---------------|----------------------------|
| Ohio (continued) | | | | | | | | | |
| Scioto | 0.75 | 1 | monolith | 2.25 | 16 | 26 | .... | concrete | 4 |
| Summit | 8.9* | 1 | grout | 22,100* | 16 | 30 | .... | concrete | 4 |
| W. Virginia | | | | | | | | | |
| Monongalia | 2.5* | 1 | grout | 27,200* | 16 | 24 | 3,100 | 1:2½:5 conc. | 5 |
| Wisconsin | | | | | | | | | |
| Walworth | 3,100* | .... | .... | 2.30† | 12 | .. | .... | concrete | 5 |

* By contract; † by day labor; ‡ does not include grading or any other work; * includes grading and culverts; † includes also 5,333 sq. yds. of concrete shoulders and all necessary culverts; ‡ 8-ft. brick and two 4-ft. shoulders; * includes road complete; † includes culverts; ‡ per cubic yard; † includes grading for thickness of pavement; ‡ includes preparation of sub-grade; † surface only, base cost \$0.90, \$1.00 and \$1.30 respectively; ‡ surface only, base cost \$4.75 a cubic yard; † includes grading.

BITUMINOUS CONCRETE PAVEMENT LAID IN 1917.

| County and State. | Amount built; miles or sq. yds. | Thickness, inches. | Cost per mile or sq. yd. | Width of pavement, feet. | Width of roadway graded, feet. | Cost of grading per mile. | Kind of base. | Thickness of base. |
|-------------------|---------------------------------|--------------------|--------------------------|--------------------------|--------------------------------|---------------------------|----------------|--------------------|
| California | | | | | | | | |
| Alameda | 57,231* | 2 | \$1.17 | 24 | 29 | \$0.135* | 1:2:4 concrete | 5 |
| Ventura | 7.6† | ¾ | .27‡ | 16 | .. | .... | concrete | 4 |
| Indiana | | | | | | | | |
| Marion | 3* | 2 | 1.65* | 24 | 50 | 0.40* | concrete | 5 |
| Maryland | | | | | | | | |
| Talbot | 12* | .. | 12,000* | 14 | 24 | 5,000 | .... | .. |
| Michigan | | | | | | | | |
| Calhoun | 3* | 2 | 1.18* | 18 | 28 |* | concrete | 6-8 |
| New Jersey | | | | | | | | |
| Burlington | 3* | 2½ | 1.35 | 18 | 30 | 0.60* | macadam | 6 |
| Mercer | 32,000 | 2 | .95 | 18 | 30 | 300 | macadam | 6 |
| Morris | 191,868* | .. | 1.00-1.50* | 18 & 34 | .. | .... | 1:3:6 concrete | 6 |
| Passaic | 97,400* | .. | 1.35* | 26 | 34 | 4,475 | broken stone | 5 |
| Salem | 2,126* | 2½ | 12,314* | 20 | 30 | 2,470 | macadam | 5½ |
| Ohio | | | | | | | | |
| Wood | 70,000* | 2 | 1.01* | 18 | 28 | 700 | concrete | 5 |
| Washington | | | | | | | | |
| Pierce | 1 | .. | 16,000* | 17 | 23 | 1,000 | concrete | 5 |

* by contract; † by day labor; * per square yard; † includes surface only; ‡ includes grading, culverts and small bridges; † per cubic yard; ‡ includes grading and culverts; † total cost of road, \$72,000; ‡ per yard.

CONCRETE PAVEMENT LAID IN 1917.

| County and State. | Amount built; miles or sq. yds. | No. of courses. | Thickness, inches. | Cost per mile or sq. yd. | Width of pavement. | Width of roadway graded. | Cost of grading per mile. | Mixture used. | Is reinforcement used? | Intervals between expansion joints |
|-------------------|---------------------------------|-----------------|--------------------|--------------------------|--------------------|--------------------------|---------------------------|------------------------|------------------------|------------------------------------|
| California | | | | | | | | | | |
| San Luis Obispo. | 10* | 1 | 4 | \$16,000 | 15 | 21 | .... | 1:2:4 | no | none |
| Santa Clara | 92,903* | 1 | 4 | 1.20* | 18 | 24 | \$1,980 | 1:3:6 | no | none |
| Stanislaus | 86* | 1 | 4 & 5 | 10,000* | 12 & 16 | .... | .... | 1:2:4 | yes | 33 ½ |
| Ventura | 48.5* | 1 | 4 | 0.75* | 16 & 18 | 28 | .... | 1:2½:5 | sometimes | none |
| Illinois | | | | | | | | | | |
| Fulton | 1.5* | 1 | 7½ | 1.25* | 15 & 20 | 30 | .... | 1:2:3½ | no | 50 |
| Kane | { 12,600* | 1 | 6-7 | 24,065* | 18 | 30 | .... | 1:2:3½ | .... | none |
| | { 12,296† | 1 | 6-8 | 16,198* | 15 | 24 | .... | 1:2:3½ | .... | .... |
| Lake | 1.5* | 1 | 7 | 1.72* | 18 | 30 | .... | 1:2:3½ | no | day's run |
| Peoria | 47,179* | 1 | 6 & 7½ | 1.42* | 15 | 25 | 1,774 | 1:2:3½ | no | none |
| Schuyler | 1.5* | 1 | 6 & 7 | 1.135* | 10 | 33 | 1,100 | 1:2:3 | no | none |
| Vermillion | 40* | .. | .... | 8,500* | 10 | 50 | 800 | 1:2:3 | no | 100 to 200 |
| Indiana | | | | | | | | | | |
| Johnson | 0.21* | 1 | 8 | 14,784* | 16 | 20 | .... | 1:2:3 | no | 20 |
| Marion | 22* | .. | .... | 1.45-1.85* | 18-30 | 50 | .... | 1:2:3 | yes | .... |
| St. Joseph | 4.9* | 1 | 6-8½ | .... | 10 & 14 | 20 | .... | 1:1½:2½ | no | 30 |
| Shelby | 600* | .. | .... | .... | 12 | 20 | .... | 1:2:3 | .... | 25 |
| Wayne | 102,000* | 1 | 6-8 | 1.30* | 18 | 28 | .... | 1:2:3 | yes | 36 |
| Iowa | | | | | | | | | | |
| Cerro Gordo | 1.5* | 1 | 6¾ | 2.23* | 16 | 24 | 1,500 | 1:2:3½ | .... | .... |
| O'Brien | 10,000* | 1 | 6 | 1.71* | 30 | .. | .... | 1:2:4 | no | 30-35 |
| Maryland | | | | | | | | | | |
| Talbot | 14* | .. | .... | 11,000* | 14 | 24 | 4,500 | 1:2½:5 | no | 150 |
| Michigan | | | | | | | | | | |
| Macomb | 2.23* | 1 | 8 | 37,100* | 20 | 28 | .... | 1:2:3 where necessary | no | 30-35 |
| New Jersey | | | | | | | | | | |
| Burlington | 1.25* | .. | .... | 2.29 | 18 | 30 | .... | 1:2:3 | yes | 25 |
| Gloucester | 8,700 | .. | .... | 1.91* | 16 | 30 | 2,618 | 1:2:3 | yes | 33½ |
| Mercer | 10,000* | 1 | .... | 0.88 | 18 | 30 | 7,000 | 1:2:3 | no | 30 |
| Passaic | 11,136* | .. | 6½, 8 & 8½ | 2.43* | 23 | 27 | 2,852 | 1:2:3 | .... | 35 |
| New York | | | | | | | | | | |
| Chautauqua | 5.5* | .. | 5-7 | 16,000 | 16 | 32 | 3,000 | 1:1½:3 | yes | 30 |
| Onondaga | 1.13* | 1 | 7 | 1.50* | 16 & 18 | 24 | 1,500 | 1:2:3½ | no | 50-100 |
| Schuyler | 4.5* | 1 | 5 | 5.50 | 14 | 26 | 2,500 | 1:2½:5 | yes | 30 |
| Ulster | 11,200* | 1 | 6 | 6.00* | 14-24 | 24 | .... | 1:1½:3 | no | 30 |
| Ohio | | | | | | | | | | |
| Huron | 104,374* | 1 | 6 | 1.29-1.70* | 10 & 16 | 28 | 1,700 | 1:1½:3 on 16-ft. roads | yes | 50 & 100 |
| Shelby | 8,676* | .. | .. | 2.25 | 16 | 26 | 2,800 | 1:1½:3 | yes | 50 |
| Oklahoma | | | | | | | | | | |
| Okmulgee | 0.5 | .. | .. | 1.78 | 24 | 28 | 720 | 1:2:3 | no | 35 |
| Washington | | | | | | | | | | |
| Pierce | 4.77* | 1 | .. | 18,500* | 17 | 23 | 2,400 | 1:2:3 over soft spots | no | 30 |
| Snohomish | 49.5* | 1 | 5-7 | 13,000 | 16 | 22 & 24 | 2,500 | 1:5 over soft spots | no | 30 |
| Whatcom | 76,000 | 1 | 5½-7 | 1.45-1.57* | 16 | 24 | 2,000 | 1:2:3 where needed | no | 30 |
| W. Virginia | | | | | | | | | | |
| Mineral | 4,467* | 1 | 5¼-7 | 1.35* | 15 | 20 | 12,000 | 1:2:4 | no | 50 |
| Monongalia | 1.0* | 1 | 6-7½ | 23,000* | 16 | 26 | 3,000 | 1:1½:3 | yes | none |
| Wisconsin | | | | | | | | | | |
| Juneau | 1.0† | .. | .. | 5.74* | 15 | 20 | 828 | 1:2:3 | .... | 35 |
| Monroe | 6.68* | 1 | 6-7 | 1.423* | 9 | 20 | 987 | 1:2:3½ on swampy land | .... | 35 |
| Outagamie | 19.75* | 1 | 6-8 | { 10,000* | 16 | 24 | 1,200 | 1:2:3½ | no | 35 |
| | | | | { 17,000* | 18 | 24 | | | | |
| | | | | { 18,000* | 18 | 24 | | | | |
| Sauk | 1.0* | 1 | 6-8 | 1.30-1.40 | 15 | 22 | .... | 1:2:3 | no | 35 |
| Shawano | 1,400* | 2 | 6-8 | 1.75* | 18 | 28 | .... | 1:2½:3 over soft spots | no | 35 |
| Walworth | 3,200* | .. | .. | 1.52* | 9 | .. | .... | .... | yes | 40 |

* by contract; † by day labor; * includes grading and 1½ inch Topeka top; † includes grading; ‡ includes concrete only; † total cost of road; ‡ includes grading and small bridges and culverts; † includes grading, draining, culverts, etc.; ‡ includes grading the thickness of the pavement; † includes grading and culverts less than 5 ft. span; † 25 ft. over soft subgrade.

GRAVEL ROADS BUILT IN 1917.

| County and State | Amount built, miles or sq. yds. | Cost per mile or sq. yd. | Width of pavement graded | Thick- ness | Cost of grading per mile | Thick- ness |
|-----------------------|---------------------------------|--------------------------|--------------------------|-------------|--------------------------|-----------------|
| Alabama: | | | | | | |
| Talladega | 5† | \$2,000 | 18 | 9 | ..... | 9 |
| Arizona: | | | | | | |
| Greenlee | 10,500 | ..... | 18 | .. | ..... | .. |
| California: | | | | | | |
| San Benito | 8 | 0.15 | 14 | .. | ..... | .. |
| San Luis Obispo | 20† | 800 ^a | 13 | .. | ..... | .. |
| Colorado: | | | | | | |
| Morgan | 45 | 500 ^b | .. | .. | \$32-\$50 | .. |
| Idaho: | | | | | | |
| Canyon | 45† | 785 ^c | 16 & 18 | .. | 175 | .. |
| Cassia | 35† | 2,100 ^a | 18 | .. | 600 | .. |
| Power | 9 | 1,800 | 16 | .. | ..... | 8 |
| Illinois: | | | | | | |
| Gallatin | 3 | ..... | .. | 14 | ..... | 14 |
| Kane | 120,000† | ..... | 8 | .. | ..... | .. |
| Lake | 15† | 2,500 | 9-12 | .. | 1,000 | .. |
| McHenry | 7.5† | 6,000 ^a | 15 | .. | 1,000 | .. |
| Whiteside | 12 | 900-6,000 ^a | 9-15 | .. | 150-1,000 | .. |
| Indiana: | | | | | | |
| Johnson | 14.91* | 4,734 ^c | .. | .. | 300 | .. |
| Putnam | 5 | 3,000-7,000 | 9 | .. | 0.20 ^c | .. |
| St. Joseph | 7.4* | 5,962 | 14 | .. | ..... | .. |
| Shelby | 14* | 3,000 ^a | 14 | .. | ..... | .. |
| Tippecanoe | 20* | 3,150 ^b | 9 | .. | ..... | .. |
| Tipton | 1* | 5,000 ^c | .. | .. | ..... | .. |
| Wayne | 2* | ..... | .. | .. | ..... | .. |
| Iowa: | | | | | | |
| Black Hawk | 5.08* | 3,800 ^c | 12 | .. | 741 | 10 ^b |
| Clayton | 1† | 1,100 ^c | 26 | .. | 1,121 | .. |
| Des Moines | 0.5 | 1,161 | 20 | .. | ..... | .. |
| Dickinson | 38.9* | 1,295 ^c | 14 | .. | ..... | .. |
| Floyd | 5,834 | 0.816 | 8 | .. | ..... | .. |
| Greene | 17* | 631 ^c | .. | .. | ..... | .. |
| Hancock | 11.25 | 746 ^c | .. | .. | ..... | .. |
| Humboldt | 16* | 928 ^c | 10 | .. | ..... | .. |
| Kossuth | 17.8* | 1,310 ^c | 10 | .. | ..... | .. |
| Lee | 0.34* | 0.30 ^c | .. | .. | ..... | .. |
| Marshall | 5* | 1,050 ^c | .. | .. | ..... | .. |
| Mitchell | 2.5† | 0.48 ^c | 12 | .. | 335 | .. |
| Muscatine | 0.09 | 0.07 ^c | 24 | .. | 1,142 | .. |
| Oscola | 1† | 1,187 | 12 | .. | 1,800 | .. |
| Polk | 5 | 1,000 ^c | 10 | .. | ..... | .. |
| Kentucky: | | | | | | |
| Trimble | 2.5 | 2,380 ^b | 9 | .. | ..... | .. |
| Michigan: | | | | | | |
| Calhoun | 40*† | ..... | 9 | .. | 911 | .. |
| Luce | 3† | 6,600 | 14 | .. | 3,000 | .. |
| Mackinac | 2† | 2,750 ^c | 14 | .. | ..... | .. |
| Macomb | 39.53* | 6,280 ^a | 9-16 | .. | 513 | 16 |
| Ontonagon | 2.5† | 4,000 ^c | 9 | .. | 500 | 10 |
| Ottawa | 10 | 4,000 ^c | 9-16 | .. | ..... | .. |
| Van Buren | 5† | 6,500 ^c | .. | .. | ..... | .. |
| Minnesota: | | | | | | |
| Anoka | 8* | 12,000 | 12-18 | .. | 2,000 | 8 |
| Brown | 10* | 800 | .. | .. | ..... | .. |
| Crow Wing | 4* | 3,500 ^a | .. | .. | ..... | .. |
| Goodhue | 4.5† | 1,100 ^c | 15 | .. | ..... | .. |
| Isanti | 6† | 4,000 ^a | 36 | .. | ..... | .. |
| Itasca | 5* | 2,000 | 16 | .. | 702 | .. |
| Nicollet | 8.87* | 616.35 ^c | 10 | .. | ..... | .. |
| Redwood | 31.8* | 700-1,500 ^c | 16 | .. | ..... | .. |
| Roseau | 2 | 2,000 | 8 | .. | ..... | .. |
| Todd | 3.5† | ..... | .. | .. | ..... | .. |
| Mississippi: | | | | | | |
| Aicorn | 15* | 3,000 ^c | 12 | .. | ..... | .. |
| Missouri: | | | | | | |
| Jasper | 37 | 635 ^c | 10 | .. | 130 | .. |
| Lincoln | 18† | 1,200 ^c | 10-24 | .. | 45 | .. |
| Miller | 15 | 1,200 ^c | 16-24 | .. | 100-200 | .. |
| Ste. Genevieve | 40 | 1,600 ^c | 12 | .. | 600 | .. |
| Washington | 15† | 2,500 | 16 | .. | ..... | .. |

WATER-BOUND MACADAM LAID IN 1917.

| County and State | Amount built, miles or sq. yds. | Cost per mile or sq. yd. | Width of pavement graded | Thick- ness | Cost of grading per mile | Thick- ness |
|----------------------|---------------------------------|--------------------------|--------------------------|-------------|--------------------------|-------------|
| Illinois: | | | | | | |
| Carroll | 0.5* | \$1,400 | 10 | 20 | \$200† | .. |
| DuPage | 7* | 4,380 ^c | 9 | 26 | ..... | .. |
| Iroquois | 2* | 6,000 ^a | 10 | 22 | 614* | 10 |
| Richland | 1.25* | 5,042 ^c | 10 | 22 | ..... | .. |
| Indiana: | | | | | | |
| Putnam | {4* | 11,000 ^b | 16 | 24 | 0.25 ^c | 8 |
| Tippecanoe | {8* | 4,800 ^a | 9 | 20 | 0.20 ^c | 10 & 12 |
| Wells | 2* | 5,982 ^a | 12 | 24 | 100 | 10 |
| Iowa: | | | | | | |
| Cedar | 0.25† | 1,188 | 18 | .. | ..... | .. |
| Lee | 13† | 535 ^c | 18 | 28 | 1,600 | .. |
| Tama | 0.75† | 2,000 ^c | 18 | 28 | ..... | .. |
| Kentucky: | | | | | | |
| Christian | 48* | 5,000 | 14 | 20 | 5,000 | .. |
| Harlan | 6* | 8,000 ^c | 9 | 20 | ..... | .. |
| Henderson | 3.5* | 7,000 ^a | 14 | 22 | ..... | .. |
| Nicholas | {2.75* | 3,200 ^c | 14 | 22 | 215 | .. |
| Trimble | {7.00† | 3,000 ^a | 9 | 16 | 130 | .. |
| Maryland: | | | | | | |
| Talbot | 18* | 9,500 ^a | 14 | 24 | 4,500 | .. |
| Michigan: | | | | | | |
| Alger | 3† | 8,000 ^c | 14-16 | 24 | 3,000 | 7 |
| Berrien | 10.75 | {8,900 | 16 | 24 | 120 | 6-8 |
| Luce | 6* | {7,100 | 12 | 24 | 120 | .. |
| Van Buren | 2† | 5,614 | 14 | 24 | 1,281 | .. |
| Minnesota: | | | | | | |
| Anoka | 700* | 0.60 ^c | 33 | 33 | ..... | .. |
| Missouri: | | | | | | |
| Jasper | 8 | 1,100 | 14 | 18 | 130 | .. |
| Sta. Genevieve | 10 | 1,800 | 12 | 18 | ..... | .. |
| New Jersey: | | | | | | |
| Mercer | 40,000* | 0.60 | 16 | 30 | 2,500 | 6 |
| Salem | 2,860* | 11,207 ^c | 18 | 30 | 3,763 | 5 1/2 |
| Somerset | 1.9 | ..... | 14 | 33 | ..... | 2 1/2 |
| New Mexico: | | | | | | |
| Luna | 11,000† | 4,750 | 18 | 30 | 750 | .. |
| New York: | | | | | | |
| Cayuga | 15.68† | 4,163 ^c | 12 | 24 | 1,088 | 8 & 10 |
| Chautauqua | 5† | 4,500 | 9 | 30 | 800 | .. |
| Cortland | 8† | 3,933 ^a | 12 | 24 | 1,181 ^a | 6 |
| Franklin | 4.1† | 2,126 ^c | 10 | 24 | 1,600 | 10 |
| Onondaga | 3.5† | not completed | 12 | 24 | ..... | 12 |
| Ohio: | | | | | | |
| Carroll | 15,867* | 0.68 ^c | 14 | 26 | 4,147* | 8 |
| Franklin | 23.28 | 8,957 ^a | 16 | 28 | ..... | 10 |
| Gallia | 2† | 11,000 | 14 | 24 | 1,500 | 6 |
| Highland | 34,000* | 0.75 ^b | 14 | 26 | 900 | 4 |
| Muskingum | 1* | 0.90 ^c | 10-16 | 20-26 | 1,350 | .. |
| Sandusky | 56,700* | 0.90 ^c | 10-16 | 20-26 | 1,100 | 8 |
| Shelby | 35,167* | 0.41 ^c | 16 | 26 | ..... | 7 |
| Summit | 2.8* | 6,663 ^a | 14 | 30 | 680 | 7 1/2 |
| Wood | 228,000* | 0.90 ^b | 16 | 26 | ..... | .. |
| Tennessee: | | | | | | |
| Cocke | 30* | 2,000 | 10 | 20 | 3,000 | 8 |
| Franklin | 45* | 3,300 | 8 | 20 | 1,200 | .. |
| Greene | 32* | 0.38 ^c | 9 | 16-20 | 1,000 | 6 |
| Monroe | 50* | 2,500 ^c | 9 | 20 | ..... | .. |
| Unicoi | 36,080* | 0.555 ^c | 9 & 14 | 24 | 1,350 | .. |
| Union | 7* | 2,800 | .. | 20 | 1,500 | .. |
| Washington: | | | | | | |
| Douglas | 214* | 2,800 | 16 | 24 | 2,700 | 6 |
| Garfield | 14,924* | 4,500 ^a | 16 | 24 | 2,500 | 7 1/2 |
| Kittitas | 9.91* | 3,974 ^a | 12 | 20 | ..... | 8 |
| Walla Walla | 36,160* | 0.568 ^c | 12 | 20 | 2,200 | .. |
| Whitman | 12 | 7,000 | 16 | 24 | ..... | .. |
| W. Virginia: | | | | | | |
| Mineral | {26,700† | 0.868 ^c | 14 | 20 | 1,000 | 8 |
| Wisconsin: | {18,100* | 0.86 ^c | 16 | 24 | ..... | .. |
| Adams | 2,605† | 0.83 | 16 | 24 | ..... | .. |

| | | | | | | | | | | | | | |
|--|---------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------------|-------------|---------------|---------|--------------------|----|----|-------|
| Door | 16 | 3,200 ^a | 9 | 23 | 800 | .. | Montana: | Carbon | 4† | 3,000 | 18 | 24 | 963 |
| Douglas | 1.5† | 0.52 ^b | 9 | 24 | ... | .. | Madison | Yellowstone | 15* | 1,400 | 16 | 18 | 312 |
| Grant | 20,000† | 0.50 ^b | 9 | 20 | 1,000 | .. | New Jersey: | Salem | 2.27* | 2,932 | 20 | 30 | 2,630 |
| Juneau | 5† | 0.75 ^b | 9 | 20 | ... | .. | New Mexico: | Luna | 7† | 3,300 | 18 | 30 | 0.24* |
| Kewaunee | 2.14 | 3,500† | 9 | 24 | ... | .. | New York: | Cayuga | 9.4† | 690 ^b | 7 | 24 | ... |
| Monroe | 26,125† | 0.805 ^b | 9-15 | 24 | 987 | .. | Franklin | Schuylcr | 7.5† | 1,547 ^c | 12 | 26 | ... |
| Ozaukee | 3.5† | 5,000 ^b | 9-15 | 24 | 1,020 | .. | Ohio: | Highland | 50,000† | 0.40† | 12 | 24 | 800 |
| Polk | 1.5† | 3,200 ^a | 9 | 20 | 1,400 | .. | Shelby | Okla.oma: | 6* | 4,100 ^b | 12 | 24 | 600 |
| Rock | 2* | 3,500† | 9 | 20 | 950 | .. | Kiowa | South Dakota: | 1† | 1,400 ^b | 20 | 24 | ... |
| Sauk | 12† | 4,500† | 9 & 15 | 20 | 1,300 | .. | Deuel | Tennessee: | 40† | 100 | .. | .. | ... |
| Shawano | 0.75† | 6.5 ^b | 9 & 15 | 28 | ... | .. | Franklin | Lawrence | 7.5* | 2,000† | 8 | 20 | 1,000 |
| Walworth | 32,700*† | 0.75 | 9 & 15 | ... | ... | .. | Taylor | Texas: | 20* | 4,000 ^c | 14 | 21 | 1,200 |
| * By contract; † by day labor; ‡ does not include grading or other work; § includes grading and culverts; ¶ includes grading, culverts and bridges; ¤ per cubic yard; ¢ includes everything; ¢ resurfacing; ¢ includes grading; ¢ reconstruction, no grading, except surfacing and ditching; ¢ includes shoulders and light grading. | | | | | | | | | | | | | |
| BITUMINOUS MACADAM PAVEMENT LAID IN 1917. | | | | | | | | | | | | | |
| County and State | Amount built, miles or sq. yds. | Cost per mile or sq. yd. | Width of pavement graded | Width of road-way graded | Cost of grading per mile | Thick-ness | | | | | | | |
| California: | | | | | | | | | | | | | |
| Monterey | 6 | \$6,000 ^a | 15 | 20 | \$450 | 6 | | | | | | | |
| Santa Clara | 20,287* | 0.52 ^b | 14 | 20 | ... | 6 | | | | | | | |
| Ventura | 0.5† | 0.72 ^b | 16 | ... | ... | 6 | | | | | | | |
| Illinois: | | | | | | | | | | | | | |
| Iroquois | 9 | 8,500 ^b | 10 | 28 & 30 | ... | 8 | | | | | | | |
| Maryland: | | | | | | | | | | | | | |
| Montgomery | 3† | 7,000 ^b | 10 | 20 | 900 | 8 | | | | | | | |
| Minnesota: | | | | | | | | | | | | | |
| Itasca | 2½ | ... | 18 | 26 | 1,500 | 4 | | | | | | | |
| New Jersey: | | | | | | | | | | | | | |
| Morris | 2 | 0.80 ^b | ... | ... | 4,000 | .. | | | | | | | |
| New York: | | | | | | | | | | | | | |
| Franklin | 4.25† | 4.861 ^a | 12 | 28 | ... | 4 | | | | | | | |
| Onondaga | 5.0† | not completed | 12 | 24 | 1,600 | 3 | | | | | | | |
| Ulster | 2.5* | 0.95 ^b | 14 | 24 | ... | .. | | | | | | | |
| Ohio: | | | | | | | | | | | | | |
| Franklin | 2.52 | 7,407 | 16 & 18 | 26 | 1,800 | 4 | | | | | | | |
| Muskingum | 12,800* | 1.13 ^b | 16 | 26 | 2,370 | 6-8 | | | | | | | |
| Scioto | 11,500* | 1.27 ^b | 14 | 26 | ... | 9-8 | | | | | | | |
| Shelby | 34,270* | 0.64 ^b | 20 | 32 | 2,000 | 6 | | | | | | | |
| Wood | 46,000* | 1.00 ^a | 16 | 26 | 700 | 8 | | | | | | | |
| Vermont: | | | | | | | | | | | | | |
| Windham | 4,200† | ... | ... | ... | ... | 2½-6 | | | | | | | |
| Washington: | | | | | | | | | | | | | |
| Walla Walla | 22,192* | 0.48 ^b | 16 | 24 | ... | 6 | | | | | | | |
| West Virginia: | | | | | | | | | | | | | |
| Barbour | 1† | 2.25 ^c | 14 | 22 | 3,500 | 8 | | | | | | | |
| Raleigh | 3.5* | 1.34-1.41 | 9† | 18-22* | 4,000 | .. | | | | | | | |
| * By contract; † by day labor; ‡ does not include grading or any other work; § includes grading; ¶ includes grading, bridges and drainage; ¢ includes grading and culverts; ¢ includes grading and ditches; ¢ includes fine grading; ¢ also 3-ft. stone shoulder on each side; ¢ 18 ft. in fills, 20-in. cut and fill, 22-in. cut. | | | | | | | | | | | | | |

BITULITHIC LAID IN 1917.

| County and State | Amount built, miles or sq. yds. | Thick-ness, inches | Cost per mile or sq. yd. | Width of road-way paved or graded | Width of road-way graded | Cost of grading per mile | Thick-ness of base, in. |
|--|---------------------------------|--------------------|--------------------------|-----------------------------------|--------------------------|--------------------------|-------------------------|
| California: | | | | | | | |
| Alameda | 35,120* | 2 | \$1.60 ^a | 18 | 20 | ... | 1:3:6 concrete |
| Ventura | 18* | 1 | 0.36 ^b | 16, 18 & 20 | ... | ... | concrete |
| Michigan: | | | | | | | |
| Ottawa | 4 | .. | 12,000 | 16 | 24 | \$400 | ... |
| Washington: | | | | | | | |
| Pierce | 5 | .. | 16,000 ^c | 17 | 23 | 1,000 | concrete |
| * By contract; † includes grading; ‡ includes surface only; ¢ includes grading, culverts, etc. | | | | | | | |

SAND-CLAY ROADS BUILT IN 1917.

| County and State | Amount built, miles or sq. yds. | Cost per mile or sq. yd. | Width of road-way paved or ment. graded. | Width of road-way graded. | Cost of grading per mile. | Thick-ness. |
|-------------------|---------------------------------|---------------------------|--|---------------------------|---------------------------|-------------|
| Florida: | | | | | | |
| Orange | 25*† | \$1,200 ^a | 9 | 30 | ... | ... |
| Georgia: | | | | | | |
| McIntosh | 5† | ... | 24 | 30 | ... | ... |
| Iowa: | | | | | | |
| Johnson | 5† | 1,000 | 18-20 | 24 | ... | ... |
| Muscatine | 1.07* | 0.05 to 0.18 ^b | 18-20 | 24 | ... | ... |
| Michigan: | | | | | | |
| Luce | 1† | 1,500 | 14 | 24 | ... | ... |
| Minnesota: | | | | | | |
| Anoka | 7* | 7,000 ^b | 14 | 20 | 1,500 | ... |
| Crow Wing | 5† | 3,000 ^c | 24 | 24 | ... | ... |
| Itasca | 4† | 1,500 ^d | 16 | 20 | ... | ... |
| Todd | 1.5† | 1,800 | .. | .. | ... | ... |

* By contract; † by day labor; ‡ does not include grading or other work; § no grading done; ¶ road complete; ¢ includes grading, culverts and bridges; ¢ includes grading and culverts; ¢ includes grading, bridges and drainage; ¢ includes grading and culverts; ¢ includes grading and ditches; ¢ includes fine grading; ¢ also 3-ft. stone shoulder on each side; ¢ 18 ft. in fills, 20-in. cut and fill, 22-in. cut.

SAND-CLAY ROADS BUILT IN 1917 (Continued).

| County and State. | Amount built; miles or sq. yds. | Cost per mile or sq. yd. | Width of pavement. | Width of road-way graded. | Cost of grading per mile. | Thick-ness. |
|------------------------|---------------------------------|--------------------------|--------------------|---------------------------|---------------------------|-------------|
| New York: | | | | | | |
| Schuyler | 3 | 200 | 16 | 26 | .... | .. |
| North Carolina: | | | | | | |
| Yadkin | 28* | 1,300 ^a | 16 | 26 | 900 | 10-12 |
| Oklahoma: | | | | | | |
| Kiowa | 3† | 500 ^b | 24 | 24 | .... | .. |
| Major | 6 | 0.30-0.50 ^c | 16 | 24 | .... | .. |
| Okmulgee | 8 | 1,600 | 16 | 24 | 530 | .. |
| South Dakota: | | | | | | |
| Deuel | 40 | .... | .. | .. | .... | .. |
| Texas: | | | | | | |
| Taylor | 5† | 250 | 16 | 16 | 100 | .. |
| Washington: | | | | | | |
| Grant | 10† | 700 ^b | 12 | 18 | 800 | 3 |
| Wisconsin: | | | | | | |
| Douglas | 8.5* | 0.10 ^b | 9 | 24 | .... | .. |
| Juneau | 3.7 | 0.25 ^b | 9 | 20 | 400 | .. |
| Monroe | 17,033† | 0.201 ^b | 9 | 20 | 987 | .. |
| Washburn | 10† | 1,805 | .. | 26 | .... | .. |

*By contract; †by day labor. ^a—includes grading; ^b—includes no grading or other work; ^c—includes grading and drainage; ^d—includes regrading old roadbed; ^e—per cu. yd.

AVAILABILITY OF ROAD MATERIALS.

| County & State. | Are there within the limits of the county adequate supplies of an acceptable quality of | | | Are Roads suitable for hauling these by motor truck? | Kind of road markers or signs used. |
|-----------------------|---|------------|-----------------|--|-------------------------------------|
| | Sand? | Gravel? | Crushed Stone? | | |
| Alabama: | | | | | |
| Talladega | ... | Yes | ... | generally | None |
| Arizona: | | | | | |
| Greenlee | Yes | Yes | ... | Yes | Sheet iron |
| California: | | | | | |
| Alameda | Yes | Yes | Yes | Yes | Wooden |
| Monterey | Yes | Yes | Yes | Yes | California Auto. Assn. |
| San Benito | Yes | Yes | Yes | Yes | Home painted. |
| San Luis Obispo | Yes | Yes | part | generally | .... |
| Santa Clara | Yes | Yes | Yes | Yes | .... |
| Stanislaus | not enough | not enough | not enough | Yes | California Auto. Assn. |
| Ventura | Yes | Yes | No | Yes | Auto. Club |
| Colorado: | | | | | |
| Morgan | Yes | Yes | No | Yes | Metal |
| Florida: | | | | | |
| Orange | Yes | Yes | No | Yes | State Auto. Assn. |
| Georgia: | | | | | |
| Laurens | ... | ... | ... | ... | None |
| Liberty | Yes | limited | none | fairly | Signs on posts |
| McIntosh | Yes | Yes | No | Yes | Wooden posts |
| Idaho: | | | | | |
| Canyon | Yes | Yes | No | a few places | None |
| Cassia | Yes | Yes | Yes | some | Board |
| Lemhi | Yes | Yes | Yes | No | None |
| Power | ... | ... | ... | ... | Steel |
| Illinois: | | | | | |
| Carroll | Yes | Yes | No | No | None |
| Christian | ... | ... | ... | Yes | Steel angle 4 x 4 x 5/16 |
| Clay | No | No | No | ... | .... |
| Dupage | No | No | Yes | Yes | Wood |
| Fulton | No | No | No | Yes | Metal and wood |
| Gallatin | Yes | Yes | No | No | None |
| Iroquois | No | No | No | not generally | Few of any kind |
| Kane | Yes | Yes | Yes | Yes | Concrete |
| Lake | partial | some | No | a few | None |
| Marshall | Yes | Yes | No | part of season | Wood |
| McDonough | No | No | No | at times | None |
| McHenry | Yes | Yes | No | when dry | Goodrich guide posts |
| Peoria | Yes | Yes | ... | Yes | None |
| Richland | No | No | No | No | None |
| Schuyler | No | No | No | Yes | Steel and wood |
| Stephenson | No | No | No | No | Enamel on iron posts |
| Vermilion | No | No | No | No | None |
| Whiteside | some | some | poor | somewhat | .... |
| Indiana: | | | | | |
| Johnson | Yes | Yes | No | Yes | Metal on concrete posts |
| Marion | Yes | Yes | No | Yes | Steel on concrete posts |
| Putnam | in some parts | ... | Yes | fair | .... |
| St. Joseph | Yes | Yes | No | most | .... |
| Shelby | Yes | Yes | Yes | Yes | None |
| Tippecanoe | Yes | Yes | Yes | Yes | Sheet iron |
| Wayne | Yes | Yes | No | Yes | Galvanized corrugated metal |
| Wells | No | No | Yes | Yes | None |
| Iowa: | | | | | |
| Adair | No | No | Not developed | Yes | .... |
| Adams | No | No | No | Yes | Wood |
| Appanoose | No | No | No | Yes | None |
| Black Hawk | Yes | Yes | soft lime stone | Yes | None |
| Cass | No | No | No | Yes | None |
| Cedar | Yes | No | No | when dry | None |
| Cerro Gordo | Yes | Yes | Yes | light | .... |
| Cherokee | Yes | Yes | No | for 1 or 2-ton trucks | Steel set in concrete |
| Clayton | Yes | Yes | Yes | Yes | Steel |
| Des Moines | Yes | Yes | No | part of time | Metal (Gallon Iron Works) |
| Dickinson | Yes | Yes | No | Yes | Pressed steel |
| Fayette | Yes | Yes | Yes | Yes | None |
| Floyd | Yes | Yes | Yes | Yes | None |
| Greene | Yes | Yes | No | Yes | .... |
| Hancock | some parts | some parts | No | Yes | .... |
| Harrison | No | No | No | Yes | None |
| Ida | not enough | No | No | Yes | .... |
| Jasper | No | No | No | Yes | Wood |
| Jefferson | No | No | No | ... | "Lyle" signs |
| Johnson | Yes | No | No | when dry | Lead on oiled cypress |
| Kossuth | No | Yes | No | fair | None |
| Lee | Yes | ... | Yes | part of time | .... |
| Lyon | Yes | Yes | No | when dry | Wood |

AVAILABILITY OF ROAD MATERIALS (Continued)

| County & State. | Are there within the limits of the county adequate supplies of an acceptable quality of | | | Are Roads suitable for haul- ing these by motor truck? | Kind of road markers or signs used. |
|--------------------------|---|---------|----------------|--|--|
| | Sand? | Gravel? | Crushed Stone? | | |
| Iowa (Continued): | | | | | |
| Mahaska | Yes | Yes | No | Yes | None |
| Marshall | Yes | Yes | No | summer only | ..... |
| Mills | No | No | No | Yes | Wood |
| Mitchell | Yes | Yes | Yes | ... | None |
| Muscatine | Yes | Yes | Yes | Yes | None |
| O'Brien | Yes | Yes | No | Yes | None |
| Osceola | Yes | Yes | No | Yes | Metal |
| Page | No | No | No | generally | None |
| Polk | Yes | Yes | No | sometimes | "Lyle" |
| Tama | Yes | No | 1 quarry | Yes | Steel |
| Webster | ... | Yes | ... | Yes | Metal |
| Kansas: | | | | | |
| Chautauqua | No | No | Yes | Yes | On poles |
| Kingman | Yes | Yes | No | Yes | ..... |
| Logan | abundant | No | No | No | Wood |
| Republic | not developed | No | No | Yes | Cypress |
| Kentucky: | | | | | |
| Christian | ... | none | Yes | Yes | None |
| Greenup | Yes | No | Yes | No | ..... |
| Harlan | Yes | Yes | No | No | None |
| Henderson | Yes | Yes | No | Yes | None |
| Nicholas | No | No | Yes | Yes | None |
| Perry | Yes | Yes | Yes | in summer | None |
| Trimble | Yes | Yes | Yes | some | None |
| Maryland: | | | | | |
| Talbot | Yes | No | No | Yes | Cast iron |
| Montgomery | No | No | No | Yes | ..... |
| Michigan: | | | | | |
| Alger | No | No | Yes | Yes | "Indestructible" |
| Berrien | No | No | No | Yes | Steel |
| Calhoun | Yes | Yes | No | No | Steel |
| Luce | Yes | Yes | Yes | Yes | "Early" |
| Macomb | No | No | No | ... | Wood |
| Otsego | Yes | No | Yes | Yes | None |
| Ottawa | Yes | No | No | Yes | Concrete post |
| Van Buren | Yes | Yes | No | Yes | Steel (Gallon) |
| Minnesota: | | | | | |
| Anoka | Yes | No | No | Yes | Metal |
| Cottonwood | Yes | Yes | No | Yes | Steel |
| Crow Wing | Yes | Yes | No | some | Metal and wood |
| Goodhue | ... | ... | ... | Yes | "Lyle" |
| Grant | Yes | Yes | No | No | None |
| Isanti | No | limited | No | No | Wood |
| Itasca | Yes | Yes | Yes | Yes | Metal and wood |
| Martin | Yes | Yes | No | Yes | "Lyle" |
| Nicollet | Yes | Yes | Yes | Yes | "Lyle" |
| Redwood | Yes | Yes | some | in part | Steel |
| Roseau | scarce | scarce | Yes | Yes | Metal |
| Todd | Yes | Yes | Yes | Yes | ..... |
| Mississippi: | | | | | |
| Alcorn | Yes | Yes | ... | No | ..... |
| Missouri: | | | | | |
| Callaway | ... | ... | Yes | No | Painted metal plate |
| Camden | Yes | Yes | Yes | Yes | Painted board |
| Carroll | Yes | No | No | Yes | None |
| Clay | No | No | Yes | fair | On poles |
| Douglas | Yes | Yes | Yes | No | Pine boards |
| Lincoln | Yes | Yes | Yes | Yes | Wood |
| Miller | Yes | Yes | Yes | part | None |
| Mississippi | No | No | No | ... | None |
| Polk | Yes | Yes | Yes | Yes | None |
| Ste. Genevieve | Yes | Yes | Yes | main ones | Painted oak and stone |
| Washington | Yes | Yes | Yes | Yes | None |
| Montana: | | | | | |
| Carbon | ... | Yes | ... | in summer | Wood |
| Gallatin | Yes | Yes | Yes | Yes | Steel and wood |
| Granite | ... | Yes | Yes | in good weather | Wood |
| Madison | Yes | Yes | Yes | Yes | Recessed metal |
| Yellowstone | Yes | Yes | Yes | No | Metal |
| Nebraska: | | | | | |
| Keyapaha | Yes | Yes | No | No | Steel |
| New Jersey: | | | | | |
| Burlington | Yes | Yes | ... | Yes | ..... |
| Gloucester | Yes | Yes | No | being built | Enameled |
| Mercer | Yes | Yes | Yes | ... | Metal |
| Morris | Yes | Yes | Yes | Yes | Wood and iron |
| Passaic | Yes | No* | Yes | Yes | Wood and iron |
| Salem | No | No | No | Yes | ..... |
| Somerset | Yes | ... | Yes | ... | 4"x30" stenciled boards on wd. posts |
| New Mexico: | | | | | |
| Luna | Yes | Yes | No | very sandy | Painted |
| New York: | | | | | |
| Cayuga | Yes | Yes | Yes | ... | Board on cedar post |
| Chautauqua | No | No | No | Yes | None |
| Cortland | No | No | No | Yes | ..... |
| Franklin | Yes | Yes | Yes | Yes | ..... |
| Onondaga | Yes | Yes | Yes | Yes | None |
| Orleans | No | No | Yes | Yes | By Auto Club |
| Scuyler | Yes | Yes | No | Yes | Steel and wood |
| Ulster | Yes | Yes | Yes | Yes | Wood boards and concrete posts |
| Washington | Yes | Yes | Yes | Yes | All kinds |
| Ohio: | | | | | |
| Brown | ... | ... | Yes | Yes | None |
| Carroll | Yes | Yes | No | No | ..... |
| Coshocton | Yes | Yes | Yes | Yes | Aluminum |
| Franklin | Yes | Yes | Yes | Yes | Metal signs, concrete posts |
| Gallia | Yes | Yes | limited | Yes | By State Department |
| Highland | part | Yes | Yes | Yes | None |
| Huron | No | No | No | Yes | Concrete posts |
| Madison | No | No | No | Yes | ..... |
| Muskingum | Yes | Yes | Yes | Yes | Metal |
| Sandusky | Yes | Yes | Yes | mostly | ..... |
| Scioto | Yes | Yes | No | Yes | Drilled signs |
| Shelby | No | No | No | Yes | Iron |
| Summit | Yes | Yes | No | Yes | None |
| Wood | No | No | Yes | Yes | ..... |

AVAILABILITY OF ROAD MATERIALS (Continued)

| County & State. | Are there within the limits of the county adequate supplies of an acceptable quality of | | | Are Roads suitable for hauling these by motor truck? | Kind of road markers or signs used. |
|-----------------------|---|--------------|----------------|--|-------------------------------------|
| | Sand? | Gravel? | Crushed Stone? | | |
| Oklahoma: | | | | | |
| Bryan | Yes | ... | Yes | No | ..... |
| Garfield | Yes | Yes | No | Yes | Paint telegraph poles |
| Harper | Yes | No | Yes | Yes | Wood |
| Kingfisher | Yes | No | No | Yes | None |
| Kiowa | Yes | Yes | No | Yes | None |
| Major | Yes | No | In west half | Yes | ..... |
| Oklmulgee | No | No | No | Yes | None |
| South Dakota: | | | | | |
| Deuel | Yes | Yes | Yes | Yes | Metal and wood |
| Tennessee: | | | | | |
| Franklin | Yes | Yes | Yes | Yes | None |
| Greene | Yes | No | Yes | Yes | None |
| Lawrence | No | No | Yes | Yes | None |
| Monroe | No | No | Yes | Yes | White oak |
| Unicoi | Yes | Yes | Yes | Yes | None |
| Union | No | No | Yes | some roads | None |
| Texas: | | | | | |
| Taylor | Yes | Yes | Yes | Yes | Various |
| Vermont: | | | | | |
| Windham | Yes | Yes | No | No | ..... |
| Washington: | | | | | |
| Adams | No | Yes | Yes | ... | Steel |
| Columbia | No | Yes | Yes | Yes | State signs, wood |
| Douglas | Yes | Yes | Yes | Yes | State signs, wood |
| Garfield | No | No | Yes | some | State signs, wood |
| Grant | Yes | Yes | Yes | Yes | State signs, wood |
| Kittitas | Yes | Yes | Yes | Yes | Wood |
| Okanogan | Yes | Yes | Yes | Yes | Wood |
| Pend Oreille | Yes | Yes | Yes | Yes | Metal |
| Pierce | Yes | Yes | Yes | Yes | Wood |
| Snohomish | Yes | Yes | none used | Yes | Various |
| Walla Walla | No | Yes | Yes | Yes | None |
| Whatcom | Yes | Yes | No | Yes | ..... |
| Whitman | Yes | Yes | Yes | not from pit | Wood |
| West Virginia: | | | | | |
| Barbour | Yes | No | sandstone | Yes | None |
| Grant | Yes | Yes | Yes | most | ..... |
| Mineral | No | Yes | Yes | Yes | None |
| Monongalia | No | No | No | ... | ..... |
| Raleigh | No | No | Yes | No | None |
| Wisconsin: | | | | | |
| Adams | little | little | No | ... | State standard |
| Douglas | Yes | Yes | No | small trucks | Metal |
| Grant | No | No | Yes | Yes | State standard |
| Juneau | No | No | No | ... | Metal |
| Kewaunee | Yes | Yes | No | Yes | State standard |
| Monroe | No | No | small amount | No | State standard |
| Outagamie | No | small amount | small amount | Yes | State standard |
| Ozaukee | Yes | a little | Yes | part | ..... |
| Polk | ... | ... | ... | ... | Enameled |
| Rock | Yes | Yes | Yes | Yes | Wood |
| Sauk | some | some | Yes | Yes | None |
| Shawano | Yes | Yes | Yes | some | ..... |
| Walworth | No | ... | ... | ... | ..... |
| Washburn | Yes | Yes | Yes | Yes | ..... |
| Wyoming: | | | | | |
| Platte | ... | ... | ... | ... | Painted posts |

*Except for concrete.

(Continued from page 317.)

material; and because of the lack of importance of some of the projects, bonds for them will not be approved.

The secretary of the Tennessee State Highway Commission writes: "The road program has been curtailed by the high price of labor, shortage of cars, and failure to sell county securities, bonds and warrants."

New York.—"Our entire program is very much curtailed by conditions due to the war. Prior to 1916 the state had been constructing improved state and county highways to the extent of about 900 miles per year, our total expenditure for construction and maintenance running as high as \$15,000,000 to \$17,000,000."—I. J. Morris, secretary of Highway Commission.

James Allen, state highway commissioner of Washington says: "The road program of this state has been curtailed to a certain extent by the high cost of labor and materials, the scarcity of labor and the lack of adequate transportation facilities. The state's road program has been carried forward to approximately 75 per cent of what would have been accomplished under ordinary conditions."

Ohio.—H. L. Hastings, chief clerk of Highway Department: "The above is in accordance with our proposed program. We cannot tell what curtailment will result from war conditions."

Oklahoma.—State Engineer Max L. Cunningham says that the road program is curtailed by transportation difficulties.

Virginia.—G. P. Coleman, state highway commissioner: "In certain sections of the state our work will be very much curtailed on account of scarcity and high price of labor. This will be more than made up, however, by the necessity for pushing the construction in other sections of the state."

Maine.—Chief Engineer of the Highway Commission Paul D. Sargent says: "We shall spend the usual amount if we can get labor to do the work. Mileage will be curtailed on account of high prices."

Arizona.—T. F. Nichols, office engineer, State Highway Department: "The bond issues have been postponed in order to assist the Liberty loans."

Connecticut.—C. G. Nichols, chief clerk of Highway Commission: "Construction work will be confined entirely to the trunk lines."

New Mexico.—Governor W. E. Lindsey says that the road program in that state is not curtailed in any way by conditions caused by the war.

New Hampshire.—F. E. Everett, state highway commissioner: "On account of labor conditions, etc., it is doubtful if 50 per cent of the above can be expended. This means that the remainder will lie over as a balance for future work."

John N. Edy, assistant engineer of Montana State Highway Commission, writes that some of the counties show a tendency to curtail their expenditures somewhat on account of war conditions, but that the estimates given by him are reasonably probable.

TRAFFIC LAWS AND HIGHWAY MAINTENANCE AND CONSTRUCTION

Wheel Loads Supportable by Different Soils—Diminishing Unit Pressure—Limiting Truck Weights—Width of Tires—State Requirements.

By CHARLES CARROLL BROWN.

The paper on traffic regulation, which was given at the St. Louis convention of the American Road Builders' Association by W. A. McLean, deputy minister of highways of Ontario, was fully up to the high standard set by the author in previous papers of his. It considered the subject from many points of view and gave rise to much discussion, which crystallized into a resolution calling for the appointment of a committee to confer with state highway authorities, manufacturers and users of vehicles and work out a definite system of regulations of traffic, covering all the points requiring such attention, such system to be recommended to the various states as rapidly as it is worked out, that the laws and rules promulgated may be as nearly uniform as possible.

WHEEL-LOADS.

Regarding the weights to be allowed for wheel-loads, the paper presented some data as a basis for their determination. It was stated that gravel would carry 8 tons per sq. ft., compressed sand 4 tons, good firm clay 4 tons, well-drained clay 2 tons, wet clay 1 ton, quick-sand or yielding soil $\frac{1}{2}$ ton. It was asserted that the load is transmitted from moving wheel to soil surface through the stone crust placed on top at an angle of about 30 deg. with the vertical, and that this must be considered as well as the bearing power of the soil.

If wheel-loads are too great to be carried on the materials in the soil over which the road is to be built, a crust (of stone in some form) must be supplied and increased in thickness and strength so that it can distribute the load over the soil and reduce it to the bearing strength of the soil. That the bearing strength of the soil to be assumed must be the lowest which it ever attains on account of absorption of moisture, disturbance by frost, etc., is evident, and the stone crust must be designed for that minimum strength, even if it lasts for but a small portion of the life of the road.

Assuming for purposes of computation a 6-ton truck with 4 tons on the rear axle and a 6-inch tire, the tire pressure per inch width of tire is very nearly the maximum allowable under Ontario regulations, 650 lbs. Some of the United States put the maximum pressure at 800 lbs. per inch of tire width; also 12-ton and 21-ton trucks are used. It has been determined approximately that a stone crust $2\frac{1}{2}$ inches thick will distribute the load over a gravel soil sufficiently to prevent yielding. These figures are extended in the following table to the different kinds of soil above named and to cover the three weights of truck:

| Kind of Soil. | Thickness of stone crust necessary to carry load on rear wheels for | | |
|-------------------|---|-----------------------|-----------------------|
| | 6-Ton Truck. Inches. | 12-Ton Truck. Inches. | 21-Ton Truck. Inches. |
| Gravel | $2\frac{1}{2}$ | 4 | 6 |
| Firm sand..... | 5 | 6 | 10 |
| Drained clay..... | 8 | 10 | 14 |
| Wet clay..... | 12 | 16 | 22 |

The combined influence of maximum wheel-load and kind of soil on the design of a macadam road is evident, and the necessity of some assumption of maximum wheel-loads before the design is made is very evident.

The same principles underlie the design of pavements with concrete base, monolithic brick and stone block pavements, etc., and economy of design, construction and maintenance demand the close coordination of weight and speed of traffic and design of pavement.

Discussion of the question of allowable wheel-loads on trucks and trailers brought out statements that steel tires are the most destructive of hard pavements, and it may in most cases be assumed that the requirement that all heavily loaded wheels shall have rubber or other like resilient tires will limit sufficiently the wheel-loads, the limitations of economy of maintaining the resilient tires being sufficiently definite to keep the maximum wheel-loads within the limits of economy in road surface design.

It was also asserted, and again denied, that the automobile-designing engineers could now state what is the most economical capacity of motor trucks. The assertion is doubtless made on the basis of the determination of the most economical capacity for a certain service or class of services. The denial is likewise based on the inability of engineers to design a truck which will be equally efficient for all classes of service, as a truck which is ample for one class must have much greater power for another; or a truck which carries economically a certain load in one service must have its capacity greatly enlarged to be economical in another service.

The fact is admitted, in any case, that there is a capacity of truck which is the most economical one for each class of service, and the maximum economical capacity for any service is that which the road-designing engineer wants to know.

Of course the exceptional use must be ruled out of this consideration. If a man wants to move a house down the street, he must prepare the street to carry the load by distributing it over the area to keep it below the maximum fixed in making the design. Likewise, if one man wants to make some special use of motor transportation he cannot require that the roads shall be constructed strong enough for his use. They must be built for the general benefit of traffic and as economically as possible for that traffic, and the special user must so distribute his load, by special means, as to keep the wheel-loads down to the maximum used in designing the road.

It is really not certain as yet what is the maximum economical truck load for any service. We have not had roads good enough for the development of all sorts of truck service. The design of the road for the maximum load must therefore be held back for future developments, and the limitations of funds and of foresight of designers will probably keep the roads somewhat under, rather than over, the strength which may be required of them by traffic which will be developed on account of their existence. Future reconstruction is often more economical than present construction on a design beyond the standard requirements of the present day. This has been demonstrated many times in the history of road and railroad construction. The only danger is in the application of the argument against the construction of roads of high class, demonstrated as necessary in a well-traveled section, in a section which bad roads have kept from development and which is only waiting for the good road to spring up to the level of its more progressive neighbors. This misapplication of the principle has caused the loss of millions of state funds in states whose road officials probably knew better, but who were prevented from applying their knowledge by those who controlled the purse strings.

Another solution of the wheel-load problem that was suggested is the multiplication of wheels, thus distributing a large truck or trailer load over two or more-wheeled

trucks so as to reduce the weight on individual wheels to the maximum that is reasonable from the point of view of the road designer. So far, this has resulted in multiplication of trucks or trailers, but there seems to be room for still better designs of wheel bases than any yet offered.

The maximum French truck was said to weigh 7 or 8 tons loaded and $3\frac{1}{2}$ tons empty, which is quite a saving to the road over the American maximum of say 12 to 15 tons loaded.

The usual soil will carry practically any weight of load which can be carried over it in dry weather, or when solidly frozen, as in northern winters. However, the road must be constructed to carry the loads during fall rains, and especially spring rains, and the breaking up of frost. In Michigan, traction engines and similar heavy vehicles are kept off the highways in March, April and May, except by permission and under strict regulation by the highway department, and the maximum load that can be carried in a vehicle is reduced 50 per cent when the roads are softened by rain or by frost coming out.

It is evident that the regulations regarding wheel-loads must be as uniform as possible throughout the country. At the same time it must be recognized that conditions differ extremely, and a set of regulations for Louisiana, for example, would not have much, if any, application to Nevada. But the vast majority of population is in states with reasonably uniform conditions, and it will be possible to develop regulations of great uniformity in a large majority of the states.

The bridge problem is one which enters as a complication, and in the poorer and less developed states the strength of the bridges will be the determining factor, rather than the quality of the road surfaces. The same is true, though probably to a less extent, of the less developed sections of each state.

The width of tire is an important factor in the regulation of wheel-loads, especially with steel tires. In Ontario this is limited by the requirement that the maximum load shall not exceed 650 lbs. per inch of tire width. In Great Britain the hard tires are varied according to diameter, also, and there is a variation in width from 5 to 15 inches on account of the combined influence of wheel-load and wheel diameter. The Massachusetts requirement is a maximum of 800 lbs. per inch of tire width. Trailers, whose steel-tire wheels meet the requirement, are doing incalculable damage to granite block pavements in Worcester, Mass., according to street superintendent Rhodes, largely because the speed is too great.

The increase in width of tire does not have much effect in distributing the load over hard pavements, because the crown of the pavements is such that the wheels bear largely on the rim of the steel tire. The same difficulty was reported by Mr. Neal from North Carolina. In building an asphalt macadam road the materials were hauled over the completed portion of the road in a truck with steel tires. The result was that the first part of the road was worn out in the process of building the more distant section. The tires failed to fit the curve of the crown and the rims of the wheels cut into the surface. A second truck had the rims beveled in an attempt to fit the crown. The destructive effect was emphasized, of course, whenever the truck turned out to pass other traffic. Possibly the destruction was partly due to overloading the truck. Putting on rubber tires stopped the difficulty, by softening the tire surface and by keeping down the load on the truck to the capacity of the softer tire. With double rubber tires but one part of the tire is in full contact with the road if the truck travels on the crown of the road. The tires are in better bearing if the driver always keeps on the right side of the road.

State Requirements as to Vehicle Weights.

| City or State. | Maximum weight on | | | |
|---------------------|-------------------|----------|-----------|------------------------|
| | Vehicle | One axle | One wheel | per inch width of tire |
| | tons. | tons. | tons. | lb. |
| Chicago, Ill. | 15 | 12 | 6 | 1,000 |
| New York State..... | 14 | 9 | .. | 800 |
| Oakland, Cal. | 14 | .. | .. | 800 |
| New Jersey | $12\frac{1}{2}$ | .. | .. | 800 |
| Pennsylvania | 12 | 9 | .. | 750 |
| Massachusetts | 14 | .. | .. | 800 |
| England | 12 | 9 | .. | 840 |

The above table is made from data given by E. W. Stern in a paper before the American Society of Municipal Improvements. In Oakland, Cal., and in Massachusetts the weight per inch of tire width does not apply to hard pavements. In England the weight on a trailer axle is limited to 4 tons, the weight of the empty vehicle is limited to 5 tons, and the combined weight of empty motor and trailer is limited to $6\frac{1}{2}$ tons. The 840-lb. weight per inch of tire is for wheels 3 ft. in diameter. For larger wheels the allowable weight is increased 91-3 lbs. per inch of increase in diameter. For smaller wheels the allowable weight is reduced 182-3 lbs. for each inch of reduction in diameter.

The State of New Jersey has done much work on this problem. In the discussion of Mr. Stern's paper is a table giving the proposed relations between speed, weight and diameter of wheel in which the permissible load on rear wheel is given, ranging from 565 lbs. on a 2-in. single tire with 32-in. wheel traveling at 20 miles an hour, to 8,625 lbs. on a 7-in. double tire with a 42-inch wheel traveling at 10 miles an hour.

(To be continued.)

PRINCIPLES OF ROAD CONSTRUCTION

Selecting Paving Material—Grade—Width—Thickness—Drainage—Foundations—Joints—Cushion Course—Finishing the Surface.

Annually since 1911 progress reports have been submitted by the "Committee on Materials for Road Construction and on Standards for Their Test and Use," of the American Society of Civil Engineers. At the annual meeting in January of this year this committee submitted its final report, which occupies 82 pages of their proceedings. The report presents first the general conclusions of the committee, which are followed by discussions of the various kinds of pavements and highway surface treatments that are in regular use at the present time; this including not only the more permanent constructions, but also earth, sand-clay and gravel. Following this is given a list of terms used in describing paving materials and methods, with definitions of each. An appendix gives a form of record for data concerning the use of highway materials, and another appendix describes the methods recommended for performing tests of non-bituminous materials, while a third gives the methods recommended for testing bituminous materials.

Because of the increasing number of those interested in the subject, as well as for the purpose of making the final report comprehensible, the committee has included conclusions or statements that may seem primary or trite to highway experts. It also has thought wise to submit in the report principles underlying the drafting of specifications. The committee "believes that competent highway engineers may meet successfully the de-

mands of any particular case by following these principles and eliminating the variables, necessarily left therein, in order to express conclusions of general application, after proper consideration of the local factors affecting them. However, it does not believe that these conclusions as to specifications will offset a serious lack of knowledge or experience in highway engineering or furnish a discriminating ability otherwise lacking."

In the introduction to the report the committee gives a list of investigations which it thinks should be made and expresses the hope that some authoritative data may in some way be secured at an early date which will throw light on the matters referred to. The committee "is impressed by the importance of the factor of costs, both as to construction and maintenance of highways, and of the need for comparable records of such data. The present situation in this respect is unfortunate, there being found available but few records of costs uniformly or logically compiled. Hence, comparisons are difficult if not impossible."

As showing the general views of the committee and their method of handling the subject, the following abstract of its "General Conclusions" is given. Limitation of space makes it impracticable to attempt even to abstract the detailed discussion of materials and methods for the several individual classes of pavements.

ABSTRACT OF GENERAL CONCLUSIONS.

Selecting Material.—One of the greatest problems for highway engineers is the proper selection of the particular material and form of construction that will most efficiently meet the conditions of any particular case. Selection of the kind of crust or pavement should be based on the following factors: First cost, maintenance cost, annual cost, ease of maintenance, durability, cleanliness, tractive resistance, slipperiness, favorableness to travel, sanitation, noiselessness, and appearance. The special value of each of these may be estimated in each case under the local conditions of traffic, surroundings, climatic conditions, and physical and financial resources, as to both construction and maintenance, with proper regard for probable or possible changes in these circumstances.

Experience has demonstrated the value of a traffic census taken both preliminary and subsequent to the construction of a highway. It is one of the most important factors in deciding the selection of type of construction best suited to local conditions, considered from the standpoints of both economy and efficiency. Census counts on any highway should be supplemented by counts on cross and parallel highways. Such a census should not be the sole basis of selection, but should be considered as a guide in determining the value of the type to be adopted. Speed as well as weight of vehicles should be recorded.

Grade.—Choice of material or methods of construction may be affected by the road grade. Conservative practice fixes the maximum limits for satisfactory results with grades as follows:

| Kind of Roadway. | Maximum Grade, % |
|-----------------------------------|------------------|
| Asphalt block | 8.0 |
| Bituminous surfaces | 6.0 |
| Bituminous concrete | 8.0 |
| Bituminous macadam | 8.0 |
| { cement filler | 6.0 |
| Brick { bituminous filler | 12.0 |
| { "Hillside" block | 15.0 |
| Broken stone | 12.0 |
| Cement-concrete | 8.0 |
| Gravel | 12.0 |
| Sheet-asphalt | 5.0 |
| Stone block { cement filler | 9.0 |
| { bituminous filler | 15.0 |
| Wood block | 4.0 |

The minimum grades allowable will depend on local conditions such as climate, type of construction, traffic, soil, etc. Except for roadways on fills, where the outside edges of the shoulders are at least 2 ft. above the level of the adjacent ground or where the roadway is laid over sand that never becomes water-logged, the grade of the road should never be less than 0.5 per cent. Under most favorable conditions, 0.25 per cent has sometimes given satisfactory results, but should be used in exceptional cases only.

Width.—In view of the continuous and rapid increase in number of vehicles and size of loads using the highways, economy requires designing highways with proper consideration of further increase. Where motor traffic comprises the largest part of that using the highway, the unit width of traffic lines should be taken as 9 or 10 ft.

The edges of bituminous pavements need protection, and sudden transition from the pavement to any soft shoulder material should be avoided by means of extra width, or by cement concrete or other edges, or such reinforcement of the shoulder material as may be necessary.

The width of roadways of rigid material should be at least equal to what would be prescribed under local conditions for a less rigid surfacing. For single-track roadways the width of pavement should be not less than 10 ft., and for two lines of traffic not less than 18 ft., unless exceptionally durable shoulders are provided. In a street or alley the width will originally be determined by the necessary location of the curb.

Too narrow a roadway causes a concentration of traffic that is apt to produce excessive wear of materials that would be suitable and efficient if the traffic were more generally distributed over it. Any tendency toward concentration of traffic in too narrow an area, as at sharp bends, should be avoided as far as possible by adjustment or separation of lines, adjustment of width, of crown or of slope of roadway.

Too great width results in unnecessary first cost and interest charges, and also maintenance and cleaning costs. In the case of pavements that require at least a minimum amount of travel to preserve the surface in good condition, excess of width may result in disintegration of unused areas which may spread rapidly over the whole pavement.

Thickness.—Determination of the thickness of a road crust or pavement should be based upon the character of the foundation and the weight of the traffic, with proper consideration of future increases in the latter. An absorbent sub-grade material likely to become soaked with water may require a thicker slab than otherwise, or even the addition of an artificial foundation in order to disperse the stresses properly from pavement to sub-grade. In some cases unusual thickness may be desirable with the use of a minimum of cement, not only for reasons of economy, but also to avoid the effects of frost. A thickness for a concrete slab exceeding 8 inches should be determined upon only after thoroughly considering the possibility of all other means of meeting the conditions, such as improving the sub-grade.

Variations in thickness of such surfacings as sheet-asphalt invariably result in non-uniformity of wear, and the same may be true of non-uniformity in thickness of other pavements as well.

Approved practice establishes the limits shown in the accompanying table for the extremes of thickness for the various layers of pavement or road crust:

Drainage.—No matter what the kind of pavement or crust, under-drainage should be provided necessary to keep the sub-grade free from moisture. Also there

Limits of Thickness for Pavement Layers.

| Kind of Roadway. | Thickness of artificial foundation* (ordinary), in inches | Thickness of sand cushion or binder course in inches. | Thickness of wearing course, in inches. |
|--------------------------|---|---|---|
| Asphalt block | 5 to 8 | ..... | 2 to 3½ |
| Bituminous surfaces ... | 4 to 8 | ..... | ¼ to ½ |
| Bituminous concrete ... | 3 to 8 | ..... | 1½ to 3 |
| Bituminous macadam .. | 3 to 8 | ..... | 2 to 3 |
| Brick | 4 to 8 | ¾ to 1½ | 3 to 4 |
| Broken stone | 3 to 8 | ..... | 2 to 3 |
| Cement- { One course... | ..... | ..... | 5 to 8 |
| concrete { Two course... | 4 to 8 | ..... | 2 |
| Gravel | 4 to 8 | ..... | 2 to 4 |
| Sheet asphalt | 5 to 8 | 1 to 1½ | 1½ to 2 |
| Stone block | 5 to 12 | 1 to 2 | 2½ to 5 |
| Wood block | 5 to 8 | 0 to ½ | 3½ to 4 |

*Not including extraordinary provisions such as V-drains or "sub-base" courses.

should be provision for surface drainage. Storm-water reaching the roadway must be carried quickly and rapidly away from it to natural watercourses. Inlets, ditches, gutters, and culverts should be designed and placed so as to be least objectionable to users of the roadway and abutting owners, and to be most durable and least expensive under all conditions. A proper longitudinal grade for ditches and gutters is particularly important; also the cross-section of ditches, so that the sides may not slide in.

Under-drainage is, if anything, even more important where cement concrete pavement or foundation is to be used, because this cannot adapt itself to change in sub-grade due to frost without cracking, as other less rigid pavements can.

The crown necessary for removing surface water to gutters or ditches should be a minimum from the point of view of traffic and wear, but some crown is necessary, varying with the type of surface. Smooth pavements should be given a very flat crown; and where the longitudinal grade is sufficient to allow the water to run freely the crown should not exceed 3 inches in a roadway 30 feet wide. The recommended practice is from 1/4 inch to 1/8 inch per foot for asphalt block, sheet asphalt, and wood block; from 1/2 inch to 1/4 inch for bituminous surfaces, bituminous concrete, bituminous macadam, and stone block; from 3/8 inch to 1/8 inch for brick; from 3/8 inch to 1/4 inch for cement concrete; from 3/4 inch to 1/2 inch for broken stone, and from 1 inch to 1/2 inch for gravel. The slope for shoulders, where these are of natural earth, is generally 1 inch per foot.

Sub-Grade.—Whatever the form of pavement, the sub-grade should be well drained, thoroughly compacted, homogeneous and stable, even when an artificial foundation is to be constructed. Uniformity in composition and compaction, as well as evenness of surface, is far more important than is generally recognized. It may even be desirable to increase the sustaining powers of the natural foundation by placing between it and the artificial foundation a layer of sand, gravel, broken stone, or similar material. A concrete foundation should not be relied upon for bridging soft spots, but these should be dug out and other material substituted and thoroughly compacted.

Artificial Foundations.—Where the character of the traffic justifies the use of an artificial surface, it also demands a **correspondingly strong** foundation. Whether or not an artificial foundation is necessary will depend upon local conditions; but in any event the greatest efficiency possible should be obtained from the natural

foundation. Foundations of ample strength and permanence are especially necessary where the wearing surface is to be of cement concrete or block pavement, owing to their inherent lack of elasticity. Local conditions may occasionally justify omitting the artificial foundation for brick pavements where the natural foundation material can be made reasonably permanent, where brick is relatively low in price, and where only light traffic is expected.

The proportioning of materials for cement concrete pavements should be made to conform to the needs and facilities of each case. Sometimes it is desirable to increase the mass at the expense of unit strength or for the sake of economy in cement.

Joints.—For the ordinary joints in block pavements, the materials and methods of filling should be selected so as to produce not only a surface that will retain to the utmost its imperviousness and the stability of the blocks themselves in place, but they should also, so far as practicable, conduce towards evenness of wear of the surface of the pavement. If the blocks are resistant to abrasion, but are inclined to round off at the edges of the upper surface under traffic, such filling of the joints is desirable as will reduce such rounding off. On steep grades, where some roughness of the surface may be desirable to afford foothold for animals, some openness at the top of the joint is desirable and the softer joint filters may be preferred.

As it is desirable to secure waterproof pavements, sand alone should never be used as a joint filler. A bituminous filler may be preferred to a cement grout filler on account of the lower cost of street opening repairs, the better foothold provided for horses, and the securing of a more elastic and less noisy pavement.

For cement mortar joints a mixture of one cement to one sand is recommended. Uniformity in mixing and care and skill in application are essential to success. To insure uniformity, there should be a constant agitation of the mixture up to the moment of its application.

For bituminous joint fillers, care must be taken to select materials which will not be too brittle in cold weather nor so soft in hot weather as to flow out of the joints. It is believed, although not yet positively proved, that the use of a bituminous mastic would be an improvement over bituminous material alone. One of the greatest difficulties with bituminous fillers of any kind is that of properly filling the joints, and great care must be taken to insure this.

Expansion-Contraction Joints.—Where expansion-contraction joints across a roadway at intervals are employed, the committee recommends the use of bituminous material and the abandonment of all forms of the so-called "armored" joints, because of the smaller interruption to the homogeneity of the road surface thus secured.

Cushion Courses.—Where a cushion course is used, its thickness should never be greater than that necessary to compensate for the unevenness of the surface of the concrete base and that in the depth of the blocks used, plus about one-half inch to produce cushioning effect. The use of a cement-mortar cushion gives a monolithic structure with perhaps greater strength, but less capable of absorbing shock without injury than where a sand or bituminous cushion is used, especially where bituminous joint filler is used.

A certain amount of loam in sand used for cushion may be of advantage in giving the sand a greater ability to resist displacement, but it should not be so loamy or fine as to prevent proper spreading and compaction, or to afford too great capillarity.

Finishing the Surface.—Pavements in which Portland

cement is used for filling the joints or in the surface itself should be closed at least two weeks after completion.

As a result of numerous observations, the committee is convinced that, in a newly-completed pavement the variations from a straight edge or templet 8 ft. long should not exceed $\frac{1}{8}$ in. for asphalt block, bituminous concrete, brick, cement concrete, sheet asphalt, and wood-block pavements, and $\frac{1}{4}$ in. for broken stone roads, bituminous, macadam and stone block.

Manhole Heads and Rails.—In the case of macadam or bituminous pavements, the pavement should be laid about $\frac{1}{8}$ in. higher than any manhole heads therein. The same should be done along street-car tracks where these are rigidly set; although the committee does not believe that a bituminous pavement should ever be laid between rails, and advises laying stone blocks or brick for at least 18 in. adjacent to the rails in the case of country highways, where the rails are not usually laid as rigid as in city streets.

BITUMINOUS AND BROKEN STONE BASES.

There are probably exceptions to almost any general statement relative to pavement conditions. The following letter from Harry E. Devereaux, city engineer of Eugene, Ore., describes conditions in bituminous pavements in that city on bituminous and broken stone bases that are at variance with those which Mr. Warren, in his letter of March 16th, described as those found in his experience:

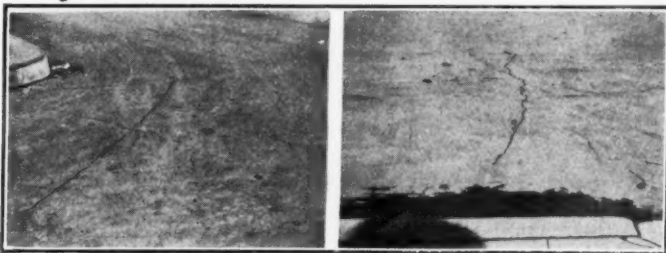
Editor Municipal Journal,
New York City.

Dear Sir:

The matter of cracks in pavements is very interesting to me and I have followed the discussions in Municipal Journal with much interest.

Contrary to Mr. Warren's statement on page 228 of your issue of March 16th, 1918, we have found that pavements on a black or rock base show more cracks than the same type of pavement on a concrete base. However, the cracks in the former rarely exceed 6 feet in length, while most of the cracks in the latter extend entirely across the roadway.

Possibly due in part to the small range of temperature here, cracks in either type of construction are more interesting than serious.



CRACKS IN PAVEMENTS ON BITUMINOUS BASE.

I enclose snapshots of Standard Bitulithic pavement on a crushed rock base laid in 1908 by the Warren Construction Co.

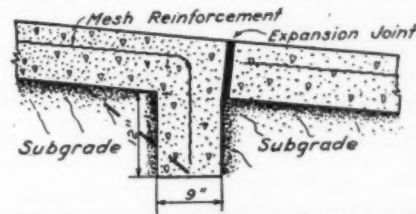
Yours very truly,
HARRY E. DEVEREAUX.

CONCRETE ROADS ON STEEP GRADES.

On both city streets and country highways it is generally very desirable to keep the grades below a limit of five per cent, where possible, but there are sections of the country and conditions of topography where a higher limiting grade must be permitted on some roads. On steep grades, water-bound macadam is found to wear so badly that some other construction is desirable. On the other hand, on the steeper grades the smoother pavements, such as those formed by the use of bituminous binders, are found to be too slippery, especially for horse-drawn traffic. Some counties have used granite block on steep grades, more to obtain a pavement that would

not be too slippery for such grades than because the maximum wearing quality was desired.

Until quite recently New York State had limited its use of concrete pavements to five per cent grades, but it is now building them on grades as high as eight or nine per cent, under certain conditions. They consider it especially adapted to grades where there is heavy motor truck traffic. With any kind of traffic, however, on steep grades it is thought desirable to secure a fairly rough surface, and in order to obtain this, as little floating as possible is employed, since the result of excessive floating is to work all the coarse particles beneath the surface. In addition to this, the surface is broomed, which adds to the roughness and gives tires a better grip on the pavement. It is not believed that scoring or marking the pavement for this purpose gives a result which is commensurate with the cost.



ANCHORING CONCRETE PAVEMENT
ON STEEP GRADE.

Also, the use of coarse sand is recommended. Gravel is not generally desirable as an aggregate on steep grades, but where it must be used it should be crushed so that at least half of the particles are broken. If care is taken in selection of the aggregate, in permitting the coarse particles to remain at the finished surface, and in lightly brooming the surface, such a pavement is found to be no more slippery than newly-laid grouted granite block.

One difficulty experienced in laying pavement on steep grades is the tendency of the pavement to move down hill bodily, or for one slab to climb over the next lower one at the joint if the joint is not exactly perpendicular to the surface, or even to crush it at this point if the concrete is lacking in strength. In order to avoid this, H. Eltinge Breed, first deputy commissioner of New York State highways, has designed a joint which is now being tried out in work in that state, the idea of which is to anchor each slab to the subgrade at its lower edge so as to prevent its down-hill sliding. The illustration shows a cross-section of the lower edge of a slab so anchored. In this case, the anchoring projection would fail of its purpose if the sliding force were sufficient to shear it off along the line of the bottom of the slab. We would suggest that the length and consequently the strength of the line of shear might be advantageously increased by making the up-hill face of the projection inclined rather than vertical, making the projection wedge-shape and increasing the length of its base two or three times, with a comparatively small increase in the amount of concrete used. Such modification is indicated by the dotted line.

ECONOMY FROM LABOR-SAVING DEVICES.

The State Roads Commission of Maryland in its latest report says: "A number of labor-saving devices have been used to keep down the cost of the work as much as possible, and machinery such as graders, steam shovels and other improved equipment have been continually used to hold the work down to the least possible cost. Taking into consideration the excess cost of materials and labor, the work has been done at less cost than heretofore, due to the use of improved road machinery, trucks, etc."

FOR FEDERAL ENCOURAGEMENT OF HIGHWAYS.

The Highway Traffic Association of the State of New York on April 16th held a conference on a number of matters of importance in connection with highway construction, maintenance and use, with special reference to the present emergency, at which it was addressed by several prominent speakers and adopted resolutions, in an effort to bring matters referred to forcibly to the attention of state and federal authorities.

The speaker of the evening was S. M. Williams, president of the Highway Industries Association, who spoke on the topic "Highway Transportation Jeopardized." He referred in emphatic terms to the great necessity of highways at the present time and to the difficulties under which the construction and maintenance of them were being carried on, these including not only scarcity of labor, material and funds, but also embargoes and other federal discouragement. He expressed the opinion that the road work would proceed in spite of these obstacles, since the traffic shortage must be and will be met in some way and the increasing use of highways is essential thereto.

He was strongly in favor of the use of prisoners in the various states on road construction and maintenance, advocating the "honor" system as being beneficial to the prisoners themselves and an economy to the taxpayers as well as aiding in meeting the labor shortage for road work. Concerning the roads themselves, he referred to the importance of not overlooking the bridges, since the carrying capacity of any road was limited to that of its weakest bridge. Following Mr. Williams' address, the following resolutions were adopted:

Whereas: The transportation requirements of the United States, due to the war, can be only met by complete co-ordination of the carrying capacities of railroads, highways and waterways; and

Whereas: There has developed in the United States a tremendous increase in highway transportation, for the haulage of munitions, foodstuffs and essential supplies; and

Whereas: We recognize the necessity of a Federal war-time policy in respect to highway improvement, permitting the various states to immediately formulate a definite highway program; be it

Resolved: That the Highway Traffic Association of the State of New York urge upon the Federal Government and the State of New York the importance of adopting a program that will ensure adequate highway construction and maintenance, so that our highways may properly carry their share of the burdens of transportation; and be it further

Resolved: That we urge upon the President and the members of Congress the creation of a centralized federal authority to determine the highway policy of our government, with power to direct the administration of that policy.

Other speakers touched upon the desirability of a traffic tunnel between New York City and New Jersey; of the designation by the War Department of certain roads as military highways, to be maintained by the federal government; the use of prisoners of war on highway work; and the further extension of the motor truck parcel-post service; resolutions expressing the opinions of the society being adopted as follows:

Resolutions Re Military Highways.

Whereas: The War Department is using many highways for military purposes, and, in many cases, army vehicular traffic constitutes a large percentage of the total traffic, and,

Whereas: Some highways so used are rapidly worn by army truck traffic, and,

Whereas: The efficient maintenance of such highways is a necessity for the rapid and economic transportation of army supplies, be it

Resolved: That the Highway Traffic Association of the State of New York petition the Congress of the United States to enact the necessary legislation to permit the construction and maintenance by the United States Govern-

ment of such highways as may be designated by the War Department as Military Highways.

Resolutions Re Prisoners of War.

Whereas: The number of prisoners of war to be transferred to the United States will probably rapidly increase during the progress of the War, and,

Whereas: The construction and maintenance of highways is of vital importance for the successful propagation of the War, be it

Resolved: That the Highway Traffic Association of the State of New York favors the maximum utilization of prisoners of war, in accordance with the provision of International Law, as labor for the construction and maintenance of interstate trunk highways and military highways under the supervision of the War Department of the Federal Government.

Resolutions Re Motor Truck Parcel Post Service.

Whereas: It has been demonstrated that proper utilization of the motor truck parcel post service will materially increase the food supply of cities and provide for quick delivery of farm products to city consumers, and,

Whereas: Such service can be conducted at a profit to the United States Government and successfully compete with railroad transportation on routes not exceeding one hundred miles in length, be it

Resolved: That the Highway Traffic Association of the State of New York petition the Congress of the United States to appropriate the sum of not less than five hundred thousand dollars for the extension of the motor truck parcel post service.

Resolutions Re New York-New Jersey Traffic Tunnel.

Whereas: The transportation of freight and the passage of vehicular traffic between the New Jersey terminals and New York City is at present inefficient, and the provisions therefore are inadequate, and,

Whereas: The New Jersey Legislature has signified by its passage of adequate legislation its willingness and desire to bear its proper share of the cost of construction of an interstate highway traffic tunnel connecting New Jersey and New York City, be it

Resolved: That the Highway Traffic Association of the State of New York favors the immediate construction of the New York-New Jersey highway traffic tunnel, and pledges itself to assist in securing the passage of the necessary legislation by the New York Legislature authorizing the construction of the interstate highway traffic tunnel.

BITUMINOUS CONCRETE IN MORRIS COUNTY, N. J.

The county engineer of Morris County, N. J., W. Hopkins, gave information concerning bituminous concrete construction in that county which was too detailed to include in the table in this issue, and which we give herewith.

Three kinds of this class of pavement were laid: Topeka, Warrenite, and Amiesite. The first was laid 34 feet wide, the second and third 18 feet wide. The first two were laid on 6-inch concrete base, for which the concrete prices varied from 75 cents to 90 cents per square yard. The Amiesite was laid on macadam base, six contracts being Telford with macadam foundation and three macadam without the Telford foundation. The last cost by contract from 48 cents to 80 cents, while three inches of macadam on six inches of Telford cost from 72 cents to 90 cents. The contract prices per square yard were as follows: Topeka—\$1.00; Warrenite—four contracts, from \$1.43 to \$1.50; Amiesite—nine contracts, from \$1.04 to \$1.30. These prices include the surface only, without any grading, base, or other work. The amount of Topeka laid was 23,016 square yards, the amount of Warrenite, 47,373, and the amount of Amiesite, 144,479.

NAMING AND MARKING ROADS.

The county surveyor of St. Joseph County, Ind., Henderson McClellan, informs us that a new road map of the county has been prepared and all the roads have been named; and that as fast as money can be raised for the purpose, signs will be placed giving the names of the roads. Three hundred and six of such signs will be required.

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Contributions suitable for this paper, either in the form of special articles or as letters discussing municipal matters, are invited and paid for.

City officials and civic organizations are particularly requested to send to Municipal Journal regularly their annual and special reports.

Information Bureau.

Municipal Journal's Information Bureau, developed by twenty-one years' research and practical experience in its special field, is at the command of our subscribers at all times and without charge.

INCREASING THE USE OF HIGHWAYS.

It has been stated that there are now considerably more than four million motor vehicles in service in the United States, and probably one million more than there were last summer. This addition would naturally result in an increase by about 30 per cent in the use of the roads of the country. There seems to be a probability, however, that the use of highways by such vehicles will be increased over that of last year by a considerably higher percentage than this because of the more intensive use of the vehicles in service. One indication of this and a factor in producing it is the return-load campaign that is being conducted in a number of states, the object of which is to assist motor trucks in obtaining loads and diverting short hauls from the railroads as far as possible. Results in Connecticut, New Jersey and practically the entire strip of country between Boston and Philadelphia indicate that motor truck traffic this year throughout that district will be at least double what it was last year.

In addition to this, a number of highways will be used for delivering, from the manufacturers to the ports of embarkation, the army trucks that are being manufactured here for use in France. Also a large part and possibly nearly all of the motor cars manufactured this year, passenger as well as trucks, will be delivered over the roads instead of by rail as heretofore.

The above influences combined seem almost certain to add greatly to the number of vehicle-miles of travel this year, and also to increase the average load carried if the return-load movement is successful in insuring that trucks will not travel empty in either direction.

One result of this may be such a concentration of motor traffic along certain highways connecting manufacturing and shipping centers that these highways will be

rendered unattractive to pleasure or tourist traffic, and such traffic will seek out and use other less direct routes. It is to be hoped these results will follow, since it would both reduce the congestion and constant delay to motor truck traffic, and also lessen to some extent the wear on the main highways used by such traffic. In fact, we suggest that drivers of pleasure cars may aid in the solution of the traffic problem if they will avoid these main trucking routes even before they are driven to do so by congestion of traffic on them.

RETURN LOADS BUREAU.

The idea of "return loads" bureaus is being adopted rapidly throughout the eastern states and has already been put into practical operation in a number of them. There would seem to be every reason why the general establishing of such bureaus should assist greatly in solving the short-haul traffic congestion, and therefore, entirely aside from any economies that may be affected, is a most patriotic move. This is the opinion of the Council of National Defense, and the Highways Transport Committee of that council is making an earnest effort to secure the establishing of such bureaus in all of the larger cities, and the smaller ones as well.

Return load service is already well established in Connecticut, and a meeting is to be held on the day that this issue goes to press with a view to organizing all of New England for this purpose. The prospects seem good for an active organization of such service in Massachusetts, Rhode Island and Connecticut, with close affiliation with New York City and later with the entire state of New York. At the request of the national Transport Committee, the Merchants' Association of New York City a few days ago appropriated \$5,000 for the purpose of creating a return load bureau in that city. In New Jersey, bureaus had on April 1st been established at six cities, and it is expected that all of more than 10,000 population will soon be provided with such bureaus, the plan being promoted there by the State Council of Defense. The Council of Defense of the state of Ohio has recommended the establishment of such bureaus by chambers of commerce in all of the large cities; and the Chamber of Commerce of Philadelphia is expecting to operate such a bureau, if indeed it has not already been put into effect. Most of the steps referred to above have been taken within the past month or two (except that in the state of Connecticut), and the spread of the movement is so rapid that almost every day sees the establishment of one or several of such bureaus.

The general idea has already been described in Municipal Journal. Some person or organization in each city consents to serve as a clearing house for bringing shippers and truck-owners together. No responsibility is assumed by the bureau, and generally no charge is made for the service rendered. The so-called bureau in different cities consists of the town clerk, the commissioners, police station, motor truck club, Home Defense League, Chamber of Commerce, Van Owners' Association, etc. A plan commonly adopted is to have the individual or office acting as the return load bureau in each city, entered in the local telephone-book under "Return loads," so that either a local or long-distance telephone call can be made to the bureau without difficulty.

The chief difficulty so far has been to sufficiently advertise the idea so that all who can or should take advantage of it may not fail to do so. Considering that the entire movement is largely a patriotic one and that no one connected with the bureau is financially benefited in any way, it would seem that the daily papers

should be willing to give publicity to the matter by frequent mention and possibly a continuous advertising until the existence and benefits of the return loads scheme is familiar to all.

COUNTY HIGHWAY RECORDS.

It is somewhat startling to learn to what an extent the county highway officials throughout the country fail to keep any adequate records concerning the road work which they perform, or at least to keep their records in such shape that they will be of any value except as mere statements of total expenditures. Several county officials have written us within the past few weeks stating that they cannot give any figures as to the cost or even amount of road work done in their counties last year because no records were kept from which they can furnish the information.

It is not merely to satisfy curiosity that cost-data should be kept, but the future development of a road system cannot be made intelligently, effectively and economically unless definite information is at hand concerning work of the past and the results obtained in the way of service rendered and the unit cost of such service. This is especially important at this time when the rapid growth of highway traffic demands improvement in construction and maintenance methods. A most important factor in deciding upon methods to be employed is the financial one of keeping total cost at a minimum; and if there are no records to show the cost of the several methods employed in the past, no reliable estimate can be made on their effectiveness and economy for the future.

It is not enough that figures should be available for one or two sections of the country or even one or two counties in each state. Each district of the country has its own problems of sub-grade, drainage, construction materials available, weather, traffic, etc., and the various combinations of these give complex problems which are the same in scarcely any two sections of the country.

Aside from this, without detailed record of the construction and maintenance of each road and the traffic carried by it, treatment of other roads or future treatment of this road will each succeeding year be a mere matter of guess work and the success or failure of the road will be a matter of chance, especially under the ever-varying conditions caused by rapid traffic development.

No man can succeed in any line of endeavor if he does not learn and profit by experience. Progress in county road work will be delayed indefinitely by failure of county officials to keep definite, detailed and intelligent records of their experiences in all branches of the operation of the roads under their charge.

ROAD MAINTENANCE AND AUTOMOBILE FEES.

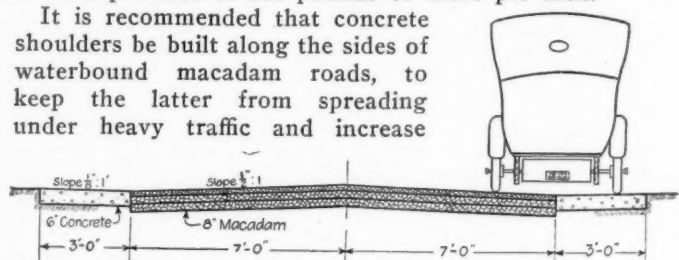
The maintenance of highways in Maryland is becoming a serious problem, and Frank H. Zouck, chairman of the State Road Commission, has made an appeal for immediate action in the matter. The present system of state roads in Maryland cannot be duplicated at this time for less than \$40,000,000, and he considers that it would be a crime to allow them to deteriorate for want of the necessary funds for their upkeep.

Freezing and thawing and very heavy traffic are the most serious factors in road destruction in that state.

Alternations of freezing and thawing weather seem to be more frequent in Maryland than further north, where the roads stay frozen, or further south, where they freeze less frequently. This is not so detrimental to concrete and asphalt roads as it is to waterbound macadam and gravel, of which there is a considerable mileage in that state.

Immediately after the construction of the present good roads the traffic over them increased in both volume and weight, the latter doing the greater injury. Mr. Zouck maintains that some limit should be placed upon the weight of trucks permitted to use the roads. It has been suggested that macadam roads should be made thicker to carry the heavier loads; but no matter how thick such a road be made, says he, wherever traffic goes over it with sufficient weight per inch of tire surface to cause one stone to grind against another it produces internal wear. A surface which has been compacted by a ten-ton roller, giving a pressure of 400 pounds per inch of wearing surface, will not long endure a traffic whose wheels exert a pressure of 800 pounds or more per inch.

It is recommended that concrete shoulders be built along the sides of waterbound macadam roads, to keep the latter from spreading under heavy traffic and increase



PROPOSED ADDITION OF CONCRETE SHOULDERS TO MACADAM ROAD.

the width. No new waterbound macadam roads are being built in Maryland, but only those of a higher type. In 1917 the state licensed 4,156 trucks with solid tires, receiving therefor \$40,337, an average of \$9.70 per truck. Twenty per cent of this goes to the city of Baltimore, and the license tags and expenses incidental to the office of the commissioner of motor vehicles require 36c more, leaving only about \$7.40 per truck for maintenance. If the average yearly mileage of a truck is 7,500, this gives less than one-tenth of a cent per mile per truck for maintenance. Of the toll roads entering Baltimore city, the last to be taken over by the state charged \$1.80 a round trip. This was used by many hucksters, who made but one trip a week. Some hucksters are now making four or five trips a week with one-ton trucks and paying a license of \$8.00 a year, or about one-fiftieth of the cost per mile that they paid the old toll road. And with this the toll road was never a paying proposition.

A macadam road in Baltimore county which was in fair condition was entirely destroyed by one truck in the spring of 1917, \$8,000 being required to restore it to its original condition. Another road in Carroll county was so damaged by a large truck hauling lumber, carrying as much as 7 tons at a time, that it cost over \$7,000 to repair the road after this hauling ceased. These instances show that certain heavy trucks are causing the State Highway Department an expenditure several hundred times as great as the fees which they pay.

The legislature of 1916 fixed, as the amount available for road maintenance in Maryland, the receipts from the automobile licenses, and at the time of the latest report this had resulted in a maintenance deficit of \$747,753. As it is absolutely impossible to maintain the roads with the license fees, and as the ever-increasing motor truck traffic will undoubtedly destroy them utterly in a very short time if they are not properly maintained, the problem confronting the commission is a serious one.

The WEEK'S NEWS

State Highway Events in Iowa, Ohio and New York—Erie's Flood Prevention Work Halted by Court—Federal Health Service Tests Vaccines—Health Officials of Country Help Food Conservation—Government's Fuel Preference List—Fires in Pawtucket, R. I.; St. Nazianz, Wis.; West Tampa, Fla., and Lancaster, Pa.—No Pay for West Virginia Councilmen—Strike in Baltimore's Street Department.

ROADS AND PAVEMENTS

Year's Highway Expenditures in Iowa.

Des Moines, Ia.—According to the latest statement by the state highway commission, during 1917 the counties and townships of Iowa spent about \$15,000,000 for roads and bridges. Of this amount \$7,728,670 was expended for roads and \$7,466,797 for bridges and culverts. The total road and bridge expenditures for 1917 exceed those of 1916 by \$828,420; those of 1915 by \$1,639,859, and those of 1914 by \$3,564,476. These increases may not be exactly correct, owing to the fact that county engineers' records for the year 1914 especially are not so accurate or so complete as during the past two years. Figures for 1916 and 1917, it is believed, will bear the closest scrutiny for accuracy and completeness. As a result of four years of operating under the cost accounting system adopted under the present road law, Iowa today knows exactly what she is spending on her roads and bridges. She has placed her whole business of road and bridge building somewhat more nearly upon the plane upon which successful private business is being operated. One of the highly satisfactory results of this comes in the positive assurance that a larger and constantly increasing proportion of her expenditures each year is for more permanent roads and bridges. In this same connection, it is worthy of note that while in 1913 and 1914 it was possible to get reports on township expenditures from but a small proportion of the townships in the state, the 1917 report is based upon a total of 1,521 townships out of a total of 1,613. Of the total expenditure for bridges and culverts on both the county and township road systems, it is stated, the percentage of money spent for work of a permanent nature amounted to 63.1 per cent or practically two-thirds of the total. The proportion of the expenditure for roads used for permanent work was 49 per cent as against 40 per cent in 1916, 41.4 per cent in 1915 and 25.3 per cent in 1914.

Ohio's Prison Road Camp.

Columbus, O.—About 14 miles from Cambridge, in Guernsey county, the state has built a new camp to house prisoners to be employed on road work. It is the state's first experiment in the use of convict labor on highway work, and state and prison officials and contractors say it is proving valuable at the very outset. From now until late summer prisoners from the penitentiary at Columbus and the reformatory at Mansfield will be sent to do a rush job of national highway paving to prepare the historic pike for the passage of 43,000 government trucks which must go through Ohio on the way to the seaboard. Seven and a half miles of very difficult highway and fourteen miles in Muskingum county are to be paved. Gov. James M. Cox declared the situation an emergency and the state determined to put convict labor on the part of the work to be done in this county and speed it by force. Fifty-five negro prisoners were sent in one batch and are working in a quarry a quarter of a mile off the road getting out rock that is to be used on the highway. The pavement will be water-bound macadam. Edgar Foy of Chillicothe, superintendent in charge for the contractor, H. Renick of Williamsport, says that the convicts make good workmen. All the men say they like the work. Most of them are men with records entitling them to parole and pardon considerations at not distant dates, and regarded as trust-

worthy. Some of them are old timers. The camp is essentially a war time camp. Two barracks buildings, one to serve as a mess hall and the other as sleeping quarters, are in use now, and a third, to provide another dormitory, is under construction. Barns have been built and a bathhouse and cold storage plant will follow. The state does not intend to place the men under the contractor and then leave them here. Baseball equipment is to be sent to the camp and teams organized. Magazines and newspapers will be provided. The men will not work Sundays and chaplains of the penitentiary and reformatory will come to conduct open air chapel exercises. The contractor pays the state highway department \$1.50 a day for each man. The state furnishes all subsistence, the supplies coming from the central warehouse of the penitentiary. The state also supervises the men. Three guards came from the penitentiaries with those now at work, and three will come from Mansfield. The men get five cents an hour, the sum they would receive for work within their institutions. C. T. Evans is chief officer of subsistence and heads the guards. A. T. Schooley of Westville, former night guard at the penitentiary, is guard captain at the quarry. The men wear no distinguishing mark that would show them to be convicts. They mess together now at the camp, but later a truck will deliver their meals to them along the road.

\$7,000,000 More for New York Roads.

Albany, N. Y.—Governor Whitman has finally signed the Sage bill which will give the state \$7,185,680.82 additional to spend for the construction and improvement of public highways under the direction of Edwin Duffey, state commissioner of highways. This amount is really the unexpended balance of the appropriation of 1916. The governor has also signed the bill appropriating \$2,090,000 for state aid for township highways, roads on Indian reservations and roads in Franklin county.

SEWERAGE AND SANITATION

Big Flood Prevention Work Halted by Court.

Erie, Pa.—Pending a possible state supreme court decision, no further work is to be done on the million dollar Mill creek flood prevention project. An opinion by judge U. P. Rossiter held that no contract existed between the city and the defunct Metz and Roth company, contractors, due to the refusal of C. L. Baker, former superintendent of city finances, to countersign the agreement. For the same reason, the opinion held, there was no contract with George Cantrell, Inc., of Philadelphia, who succeeded Metz and Roth on a "cost plus" basis to complete the work when the latter company went bankrupt and quit work. Judge Rossiter's opinion reviewed the project from the spring of 1916 when a bond issue of \$950,000 was authorized at the polls for the improvement of Mill creek, to prevent the repetition of the flood of the preceding August. The opinion was in answer to a bill in equity brought by T. A. Lamb, attorney, to prevent continuation of the Mill creek work under a continuation contract with Cantrell, after Metz and Roth quit. As a result of the bill, council was restrained from going ahead with the project pending a court order. When C. L. Baker, as finance superintendent, refused to countersign the Metz and Roth contract, he gave as his reason the argument that the contract was

illegal because the actual money was not on hand in the form of a specific appropriation. The decision says in part:

"In the case at bar there was admittedly no attempt whatever to certify. It is certainly the fact, and it is conceded by all parties to this suit, that there was no certification by the superintendent of finance. It does not certify that the controller had charged the amount of the expenditure for this improvement against the appropriation (even if there was an appropriation, which is disputed) which was made for its payment. There was no certification made at all, and the statutory consequences of such omission is that the contract between the city of Erie and the Metz and Roth Company, Inc., cannot take effect as a contract."

"This is not a case where part of the funds were to be raised by the assessment of benefits. It was all to be raised from the assessment of benefits. It could not avail, for neither that nor any other certificate appears on either of the contracts."

"The infirmities of human nature, the natural disposition to favor friends, personal and political, and the various motives which influence public officers to depart from a strict and rigid adherence to the obligations that rest upon them as representing the public, make it important that they should be held strictly within the limits of the powers conferred upon them."

The court then asks the question: What effect does the fact that the Metz and Roth company contract does not take effect as a contract, have on contract?

"The question really is, Of what force is a contract that is let to complete a contract that cannot take effect as a contract. The inquiry answers itself. If the original contract cannot take effect as a contract, then it cannot be either commenced or completed. Hence, as the Metz and Roth Company, Inc., contract cannot take effect as a contract, it cannot be completed as a contract, for it never could commence as such."

"The contention of the city, however, is that the Cantrell contract does not depend on the Metz and Roth contract for its efficacy; that it is not auxiliary thereto, or in any way connected therewith, derives no start or impetus therefrom, but stands as an independent undertaking. In this we do not agree for the reasons that after the withdrawal of the Metz and Roth Company, Inc., the idea, as gathered from the subsequent proceeding, seems to have been that under Section 91 of that contract, the city had the right 'to proceed to complete the work at the sole charge and expense of the city and recover damages from the contractor for the breach of the contract,' and that 'they had the right to take possession of the work and the entire plant of the contractor,' and in accordance with this idea the resolution authorizing the city engineer to advertise for proposals 'for the purpose of completing the Mill creek improvement in accordance with the Metz and Roth contract,' was followed by the resolution, authorizing 'the mayor and engineer' to employ Cantrell to complete the Metz and Roth contract."

"But supposing, for the sake of the discussion, that the Cantrell contract was intended as an independent contract, and not as auxiliary, continuing or completing the Metz and Roth contract, what then do we find? We find that it was a contract involving the appropriation of money; that there was no independent designated item of appropriation on which it was founded; no estimated amount of estimate and a cost plus percentage expenditure thereunder, which is charged against an independent designated item of appropriation, unless the profit is an estimate (which we do not decide), and no certification on the contract by the superintendent of finance that such appropriation and estimated amount of expenditure has been charged against that designated item of appropriation; all of which are conditions precedent to the legal efficacy of the contract, and the absence of any one of which is fatal to it as a contract."

"It is therefore apparent that the George E. Cantrell contract cannot stand either as a contract completing the Metz and Roth contract or as an independent self-supporting contract itself, but that considered either way it is inefficient and must fall."

U. S. Public Health Service Testing Vaccines.

Washington, D. C.—In order that there may be no doubt of the effectiveness of the serums and vaccines most in use both in the military forces and in civil life, the United States Public Health Service is now making tests of samples from every lot of these products made by the various manufacturers. The tests are made at the hygienic laboratory in this city before the products are placed on the market for sale in interstate traffic. The seriousness and prevalence of pneumonia and meningitis at the present time make it of the greatest importance that the reliability of any individual dose of the serums be guaranteed. As rapidly as possible the Public Health Service has been determining upon standards for the different serums and vaccines used in preventing disease, and where sufficiently accurate standards could be found it has held the manufacturers up to them. Tests for reliability are now made in the case of serums and vaccines used in pneumonia, meningitis, smallpox, typhoid fever, diphtheria, and tetanus. Since 1902 the Public Health Service has had supervision by law over the manufacture of viruses, serums, and toxins to be sold in interstate traffic. At the present time a large number of firms are licensed for the manufacture of these products. This means that their establishments are satis-

factory from a sanitary point of view and that their products are free from contamination. In the case of the serums used in the six diseases mentioned it means, moreover, that the products, as made, have been found capable of preventing the diseases they are to be used against.

Tracing of Typhoid Carrier Halts Epidemic.

Superior, Wis.—What threatened to be a serious epidemic of typhoid fever in this city has just been successfully averted. Nine cases of the malady broke out on one milk route, but it was successfully checked by Dr. D. R. Searle, city health commissioner; William Strasser, city bacteriologist, and Emil Haeske, milk inspector. This fight against typhoid is one of the most interesting in the city's history. Two previous outbreaks of the disease had occurred on the same milk route, but the cause of the trouble has been removed at last. A dairyman's wife and son have been discovered to have carried the disease for 16 years. Health commissioner Searle gave it as his opinion that if the epidemic had not been stopped when it was, it might easily have affected hundreds of persons. When a cousin of one of the dairy farmers who supplies Superior's retail milk demand came over from Duluth sixteen years ago to recuperate from an illness with typhoid fever, this was the first link in the chain of infection, according to the authorities. Next the dairyman's wife became ill with the disease, also one of his sons. Both recovered completely. However, health department officials have found that the woman had been a carrier of typhoid for sixteen years and both herself and her son have been carriers of para-typhoid for that length of time. One case broke out on the milk route more than a month ago, but it was not reported immediately by the physician in charge. Then two more cases broke out and the health department began to investigate. The milk supply was immediately subjected to pasteurization. Blood and other tests were made on all members of the family and the premises were cleaned up on the dairy farm. Those who were found to be carriers of the disease were isolated.

Health Officials Cooperate on Food Conservation.

Washington, D. C.—State health officers of the country will actively cooperate with the federal food administrators of the various states. This is a result of an offer by the American Public Health Association to have its members assist in carrying on the work of food conservation in the states. The administrators have been requested to communicate with the health officers of their respective states and decide upon a method of utilizing the newly acquired and valuable assistance. Each state has a health department, the head of which is a member of the American Public Health Association. In each of the 3,100 odd counties there is a county health officer, and in many states township health officers as well. There are some 235 cities, each with a health officer in touch with the state health department. Altogether there are approximately 40,000 people employed in some capacity by these various health agencies. There are also about 150,000 physicians closely connected with the local health officials, and the public health association has assured the food administration that most of the physicians would be able to serve the cause of food administration in some capacity.

WATER SUPPLY

To Make Plant Self-Sustaining with Higher Rates.

Yonkers, N. Y.—Following approval given by the common council to the proposed ordinance imposing a frontage tax of 5 cents a foot on all property along streets where water mains are laid, public works commissioner See prepared a new scale of water rates, which became effective on April 1st. Henceforth the water used for factories and mechanical purposes will be sold by the city at the flat rate of 10 cents per hundred cubic feet. At present the price to the manufacturing consumer has ranged from 8 cents to 13 cents, the average price being 9 cents a hundred cubic feet. The new schedule provides that water used for any and all other purposes will be sold

at the rate of 16 cents, an increase of one cent on the hundred feet. In addition to this the minimum rate for all dwellings, stores, shops, hotels, factories, livery stables, wharves, barns and other buildings, establishments and trades, yards and other premises having connection with the city water mains will be \$2 per quarter instead of \$1, as heretofore. When mayor Wallin presented the bill for the frontage tax to the board of aldermen he announced that if the proposition was not put into effect it would be necessary to increase the price of water to the household consumer to 22 cents in order to put the water bureau on a self-sustaining basis. If the frontage tax is approved by the legislature he hopes, with the one-cent increase in price just announced, to bring the revenue up to the point where the old deficiencies of the water bureau can be wiped out and the department run in future without a loss.

\$1,250,000 Water Works Bond Issue Approved.

Kansas City, Mo.—The voters at the recent special election decided in favor of the proposal to issue bonds in the sum of \$1,250,000 for the purpose of constructing a new waterworks pumping station and a gravity flow conduit 22,000 feet long, by a vote of 33,583 to 2,858. More money will be added to the amount of the issue from the funds of the water department. Work will be done under the chief engineer of the department, Burton Lowther.

Out-of-City Consumers to Pay More for Water.

Ontario, Cal.—Consumers of water from the municipal system residing outside the city limits will pay 50 per cent more for their water than those residing within in the future, as the result of action taken by the city council. Heretofore inside and outside users have been paying the same rate, but in considering the matter the board took the stand that outside consumers are really getting their water for less than those inside, since the former pay no city taxes for the upkeep of the system. The present rates are \$1 minimum for the first 1,000 feet and 50 cents a 1,000 for all excess. The new outside rate will be \$1.50 and 75 cents.

STREET LIGHTING AND POWER

Commission Order Stops Free Extensions.

Springfield, Ill.—The Commonwealth Edison Company and the Public Service Company of northern Illinois filed with the state public utilities commission last November a petition for the suspension during the period of the war of the utilities rule which provides for free extension to prospective customers, provided that the line extension does not require more than twice as many poles at standard spacing as there are individual applicants. It also provides for charging for extensions above the free limits. The petition was contested by attorneys for several real estate boards in the territories of the petitioning utilities. In its decision the commission modifies the rule as follows:

That present conditions warrant a modification of the rules of the commission governing the making of extensions for serving new business, and that by the modified rules the petitioners may require a deposit from customers who desire an extension of the petition in the amount of the cost of such construction, but that such a cost used as the basis for deposit would not include any amount for distribution transformers, for service connections of ordinary lengths extending from the pole lines or underground conduits to consumers' premises, or for consumers' meters, and that service should be rendered to any consumer complying with these deposit conditions unless an individual case is of such character that it appears that the revenue anticipated from the extension will not provide at the expiration of five years an adequate return upon its cost.

The commission further finds that in the case of extensions made for power service repayment of the deposits collected should be instituted immediately upon the cessation of the war, and that the amount of such monthly repayments should not be less than 25 per cent of the net bill for service, and that in the case of extensions made for lighting service repayment of the deposits collected should be made monthly at a rate of 25 per cent of the monthly bills, and that such repayment should be instituted with the first bills for service rendered.

The commission further finds that interest should be paid at the rate of 5 per cent per annum upon that portion of the deposit held by the petitioners which exceeds the cost of a free extension as defined by the original Rule 31 until such a time as the repayment shall have amounted to the cost of such free extension, and that interest at the rate of 5 per cent per annum should be paid upon the entire deposit until

such time as repayments are instituted in accordance with the conditions herein set forth. In securing interest due in order to avoid the complication of interest computations on various amounts, such interest after repayments have been started may be computed over the entire period for which it is to be paid upon one-half of the gross amount of the excess deposit.

In their petition the applicants appear to be governed by patriotic motives to an extent fully as great as by any pecuniary advantage which might result from deferring extension until a more advantageous time. From the standpoint of personal interest, the extension of utility service involves the payment of larger sums of money for lines and station capacity and other necessary improvements than would be necessary for the development of the systems under normal conditions. From a patriotic standpoint it involves the employment of material and labor, of which the country faces a scarcity, and the utilization of capital which may be necessary for governmental needs in the prosecution of the war.

City Protests Against Gas Rate Ruling.

Newark, N. J.—Argument was heard by the state public utility commission at Trenton upon an application of Newark for a reopening of the cases in which the commission recently granted permission to the Public Service Gas Company and the Public Service Electric Company to increase their rates. Jerome T. Congleton, who appeared for Newark, took exception to the decision of the board under which the rate increase was made applicable to the February bills, which included gas and electricity consumed during the last few days of January. Mr. Congleton contended that the board had exceeded its powers in attempting to make the rates retroactive and no order of the board should become effective until the expiration of twenty days from the date of issuance. Ralph W. E. Donges, president of the board, suggested that Mr. Congleton had misapprehended the actual condition and remarked that, in permitting the increase, the board had filed no order, but had merely permitted a tariff of rates submitted by the companies to become effective. Mr. Donges said the question involved at the hearings was not whether the proposed rates were reasonable, but whether the board should exercise its power to suspend them, pending an investigation and determination of their reasonableness. Having decided that the prima facie case did not warrant a suspension of the rates, even though the increase suggested had been modified by the board, Mr. Donges said it required no action further than a decision not to order suspension to make the rates effective.

Preference List for Fuel Priority.

Washington, D. C.—The War Industries Board of the Council of National Defense has authorized the following statement: The Priorities Board has adopted Preference List No. 1 for the guidance of all governmental agencies in the supply and in the distribution by rail or water of coal and coke. While the list speaks for itself, it is proper to say that the board has not undertaken to classify any industry as nonessential or at this time to limit the quantity of fuel which any particular industry or plant shall receive. The board has, however, listed certain industries whose operation is of exceptional importance, measured by the extent of their direct or indirect contribution either toward winning the war or toward promoting the national welfare, and these industries will be accorded preferential treatment by the Fuel Administration in the distribution of coal and coke, and also in the transportation of such coal and coke by the railroads. This same plan will be followed in according preferential treatment to war industries and plants in the transportation of raw materials and supplies required by them in their manufacturing operations, so that they may not be delayed or hampered in complying with priority orders issued against them governing their products. Preference List No. 1 is not complete in itself, but it will be noted that provision is made for certifying additional classes of industries, and also individual plants whose operations are necessary as a war measure. In determining what industries or plants are entitled to be certified, two factors will control: (1) The relative urgency of the uses or purposes for which the product of the plant is utilized; and (2) the per cent of the product of the plant utilized in war work, direct or indirect, or work of exceptional or national importance.

No plant, a very substantial per cent of whose product is not of exceptional importance, can be accorded preferential treatment. The priorities commissioner shall, under the direction of and with the approval of the Priorities Board, certify additional classes of industries, and also certify individual plants whose operation as a war measure is of exceptional importance, which industries and plants when so certified shall be automatically included in this Preference List, which shall be amended or revised from time to time by action of the Priorities Board to meet changing conditions.

No distinction is made between any of the industries or plants which are or may be included in this Preference List, and no significance should attach to the order in which the industries or plants appear in the list: Aircraft, plants engaged exclusively in manufacturing aircraft or supplies and equipment therefor; ammunition, plants engaged in the manufacture of ammunition for the United States Government and the allies; Army and Navy cantonnments and camps—arms (small), plants engaged in manufacturing small arms for the United States Government and for the allies; chemicals, plants engaged exclusively in manufacturing chemicals; coke plants; domestic consumers; electrical equipment, plants manufacturing same; electrodes, plants producing electrodes; explosives, plants manufacturing explosives; farm implements, manufacturers exclusively of agricultural implements and farm-operating equipment; food and food plants—feed, plants producing feed; ferroalloys, plants producing; fertilizers, manufacturers of fertilizers; fire brick, plants producing exclusively; food, plants manufacturing, milling, preparing, refining, preserving, and wholesaling food for human consumption; food containers, manufacturers of tin and glass containers and manufacturers exclusively of other food containers; gas, gas-producing plants; gas, plants manufacturing exclusively gas-producing machinery; guns (large), plants manufacturing same; hemp, jute, and cotton bags, plants manufacturing exclusively hemp, jute, and cotton bags; insecticides, manufacturers exclusively of insecticides and fungicides; iron and steel, blast furnaces and foundries; laundries; machine tools, plants manufacturing machine tools; mines; plants engaged exclusively in manufacturing mining tools and equipment; newspapers and periodicals, plants printing and publishing exclusively newspapers and periodicals; oil, refineries of both mineral and vegetable oils; oil production, plants manufacturing exclusively oil-well equipment; public institutions and buildings; public utilities; railways; railways, plants manufacturing locomotives, freight cars, and rails, and other plants engaged exclusively in manufacture of railway supplies, refrigeration, refrigeration for food and exclusive ice-producing plants; seeds, producers or wholesalers of seeds (except flower seeds); ships (bunker coal), not including pleasure craft; ships, plants engaged exclusively in building ships (not including pleasure craft) or in manufacturing exclusively supplies and equipment therefor; soap, manufacturers of soap; steel, steel plants and rolling mills; tanners, tanning plants, save for patent leather; tanning extracts, plants manufacturing tanning extracts; tin plate, manufacturers of tin plate; twine (binder) and rope, plants producing exclusively twine and rope; wire rope and rope wire, manufacturers of same.

FIRE AND POLICE

Big Blaze in Machinery Plant.

Pawtucket, R. I.—Fire of suspicious origin consumed several hundred thousand feet of lumber and did damage estimated at more than \$150,000 at the plant of the Narragansett Machine Company. The establishment is engaged on orders for the government, making machinery for munitions plants and winches. The blaze practically destroyed the concern's large stock of lumber in addition to burning out departments used in the manufacture of gymnasium apparatus. The main plant, containing the machine shop, was not damaged by the fire except the damage done by water leaking from hose stretched through the building. With a strong breeze fanning the flames the firemen had hard work to keep the fire from spreading to the main buildings of the plant. According to chief Fuller some of the damage could have been averted if there were more hydrants in the yard of the plant. When the fire was hottest a careful watch was kept over two tanks containing naphtha and enamel, which were in danger of being ignited. The fire started in a corner of an old locker shed and several minutes after the alarm was sounded worked its way between the partitions to the enamel room. Before the firemen arrived upon the scene the blaze followed the walls and worked nearly the entire length of the enamel room, which is more than 400 feet long. The old locker building was a mass of flames and the blaze jumped the spur trackage and ignited the large lumber sheds. Chief Fuller saw that the blaze was rapidly gaining headway and immediately upon the arrival of the apparatus hose was laid from every available hydrant.

Ten streams were throwing water into the flames twenty minutes after the alarm was sounded. A general alarm was pulled by chief Fuller and the firemen from Central Falls moved into the fire headquarters to assist the Pawtucket firemen. Twice during the evening chief Fuller sent the auto wagon back to headquarters to bring more hose to the scene of the fire. The firemen were handicapped by the necessity for laying long lines of hose before the flames could be reached. The shortest line was carried more than 700 feet before it could be used. The men fought the blaze in the enamel shop and confined the burning to one-half of the structure. The centre building of the lumber sheds caught fire and the intense heat prevented the firemen from fighting the flames at close range. Chief Fuller withdrew several lines of hose from each side of the enamel building and began the fight to try and save the lumber sheds where more than 3,000,000 feet of wood was stored. The firemen were rewarded with the saving of the large three-story lumber shed adjoining the machine shop and the small two-story shed.

Four Fire Departments but No Water.

St. Nazianz, Wis.—Fire starting from an explosion of a gasoline tank in a garage in this village, ten miles east of Kiel, swept the business block of the village, destroying seven dwellings, the state bank building and a general store housing the telephone exchange. The fire raged all day, fanned by a brisk wind. It gained headway when a bucket brigade failed to cope with it and lack of water prevented fire departments from Kiel, Valders, New Holstein and Manitowoc, which came to aid, from checking the fire. Water was obtainable only from a small lake. St. Nazianz is the seat of a Catholic seminary, which, however, was not touched by the fire.

Firemen Try to Become Policemen for More Pay.

Richmond, Va.—Firemen who aspire to become policemen are jeopardizing their jobs with no prospect of winning the blue uniform and badge, according to several members of the fire department who recently resigned with the expectation of being appointed to higher salaried positions on the city's payrolls. The complainants say they learned only after relinquishing their places in the fire department that an "agreement" exists between the police and fire department officers that no ex-firemen shall be taken on the police force. They allege that this is an illegal restriction on their rights as citizens. It was explained to them, they assert, that an agreement of this kind was found necessary because a stampede from the fire department to the police force had begun. It was necessary to discourage firemen in order to keep the fire companies up to service strength. The attraction the police force holds for the firemen is higher pay, combined with shorter hours. The grade B fireman is paid \$1,120.40 a year, the police patrolman \$1,212.53. Except when he has his regular days off, the fireman is in service twenty-four hours a day. The policeman works eight hours. Secretary L. S. Jones, of the fire department, when asked if the board of fire commissioners had entered into the agreement with the chief of police or the mayor, denied the report. He said the board of fire commissioners had taken no action whatever on the matter. He was confident that the board members knew nothing of the agreement, individually or as a board.

Business and Residence Section Swept by Fire.

West Tampa, Fla.—Fire which originated in an abandoned cigar factory swept that part of West Tampa from Cleveland avenue to the business section, destroying over a hundred residences in addition to the city's most valuable business houses. The loss is estimated at least \$250,000. No cigar factories were burned. The fire started about 3 o'clock in the afternoon, and was brought under control about five hours later. The first area swept clean by the flames constituted about five solid blocks of closely built houses. The flames then jumped to the alley between Green and Laurel streets, the number of houses burned in this section being about twenty. The residences were occupied by Latins, many of whom lost their entire home furnishings, and spent the night in the streets, bedded

upon mattresses. The civilian relief committee of the Red Cross issued a call for clothing, money, food and other things which can be used for the relief of the unfortunate people. As the flames spread from the old cigar factory to the residences nearby the West Tampa fire department, unable to cope with the flames, was reinforced by units from the Tampa fire department, but the combined efforts of the two departments proved ineffective as the flames swept rapidly from one frame building to another, consuming them with great rapidity. One by one the buildings were burned and the firemen retreated, making a desperate stand when the business section of the city was reached. The gas company, electric light company and telephone company rushed crews to the scene to save telephones and gas meters. Current was cut off from the trolley wires and when the flames slowly died out West Tampa was in darkness. The few injuries reported as resulting from the fire is considered remarkable under the circumstances. Efforts on the part of the police to control the crowds which surged forward and hampered the work of the firemen were without avail, and as the flames spread and the business district was threatened fire chief W. M. Matthews requested Maj. D. F. Conoley to call out the home guards. Within thirty minutes fifty members of the armed guards in full uniform were on the grounds, and within an hour 150 men were on duty. The residence of mayor O'Halloran was one of those destroyed.

Lancaster Firemen Fight \$200,000 Blaze.

Lancaster, Pa.—A \$200,000 fire wiped out a large seed and implement establishment in the commercial district of the city. The fire raged for three hours fanned by a stiff east wind which made the conditions look bad for the adjoining buildings, but the fire was confined to the one building, which was three stories high, 30 feet wide and 240 feet long. The fire started in the middle of the building near the elevator shaft. As no fire was known to have been in the building and the main electric switch turned off, the only cause to which it is thought the fire might be ascribed, is a gas explosion. The water department men were called into service to help handle the twenty-two lines of hose to fight the fire as well as to help save other buildings. It just happened that a large number of soldiers were in the city to help boost the Liberty Loan and a majority of them were on the job and did good service. This fire gave the new electric driven centrifugal pumps a test as they were using at the rate of 5,000 gallons per minute and, according to a communication from secretary John T. Brainard of the water department, two pumps held the pressure for the entire city at 108 pounds. Fortunately for Lancaster the fire department did excellent work under its efficient head, chief William Johnson, and his brigade were fully equal to the occasion. Lancaster has five companies and two truck companies, all motorized except one. This one will be equipped in the near future.

Retirement Denied to Police Chief.

Yonkers, N. Y.—Police chief Daniel Wolff, who applied recently to be placed upon the retirement list, has been found physically fit to continue his duties as head of the police bureau. The committee of local doctors appointed by public safety commissioner Mitchell to examine into the chief's claim that he was not able to continue because of illness, submitted the following report: "We find that chief Wolff is suffering from a double hernia and a mild form of diabetes; that his physical strength is but slightly impaired; that he is physically able to do a limited amount of work; that we find him in his present condition able to work for the force of which he is a member." Commissioner Mitchell, upon receipt of the report, asked Dr. A. C. Benedict, the chairman, for further particulars regarding the physical examination that had been made. He asked whether the condition of the chief could be cured by operation or by form of treatment. He also requested Dr. Benedict, who is surgeon of the police bureau, to submit to him a report on the chiefs' condition during the ten years that the latter has been in the department. The chief in his application claimed a pension under the disability clause in the law. He receives a salary of \$3,300 a year; if retired would have drawn \$1,650 from the city annually for the remainder of his life.

GOVERNMENT AND FINANCE

Would Vote Again on Manager Plan.

Sioux Falls, S. D.—A petition bearing 710 names of voters of the city has been filed with the city auditor asking the city commissioners to call an election to submit to the voters of the city the proposition of putting Sioux Falls under the city manager form of government. The petition, it is claimed, bears 65 more names than is required by the law, and those who are behind the city manager plan hope that the city commissioners will call the election. Sioux Falls recently voted in favor of the city manager plan, but the law was attacked and declared unconstitutional by judge J. W. Jones. Then at the special session of the legislature two bills were rushed through to correct defects in the original bill and it is under these laws that the petitioners seek to have another election called.

Not Authorized to Pay Councilmen.

Charleston, W. Va.—Members of council in towns and villages incorporated under the general law cannot receive compensation for their services, no provision having been made for such compensation under the general law and the acts of the legislature of 1915 providing that it shall be unlawful for the council of any municipal corporation "to expend any money or to incur any obligation of indebtedness which such tribunal is not expressly authorized by law to expend or to incur." State tax commissioner Walter S. Hallanan has so ruled in construing the statutes with regard to the duties and compensation of council members, and the recorders of West Virginia towns incorporated under general law were notified of the ruling. "In making audits of municipalities we find that in a number it has been the practice for the town or village council to receive compensation for their services," says commissioner Hallanan's letter to the recorders. "We have made an examination of the statutes and are unable to find any law authorizing members of council to receive compensation for their services in towns or villages incorporated by authority of the circuit court."

STREET CLEANING AND REFUSE DISPOSAL

Laborers Strike—Streets Unswept.

Baltimore, Md.—Rejecting the plea and proposals of mayor Preston, to return to work, the city laborers' union formally voted to strike at once to enforce a demand for \$3 a day for laborers in all departments. The city offered \$2.76. About two thousand men went out. Mayor Preston told the men the city would recognize the union, but he declined all propositions laid before him for the wage increase demanded. The streets remained unswept.

Federal Investigation Finds Food Waste in Garbage.

New York, N. Y.—The results of the federal food board's efforts to ascertain, through inspection of garbage cans, how much food is thrown away in the average household, were recently made public for the first time in the report of Miss Margaret Butler. Miss Butler included in her survey all of the main apartment house districts of the city. On the whole she found the garbage output had decreased to about half of what it was in pre-war times, although, she said, in districts here and there "enemy alien servants" were apparently doing all in their power to increase rather than decrease the amount of waste. Her investigation lasted five weeks. She found many instances where large quantities of breads and meats had been thrown into garbage pails that might have been used for human food. Porters gathered bread in many places, according to her observations, and sold it for chicken feed. In some places the pieces of bread were so small as to indicate that there had not been any willful waste or deliberate disregard of the appeals of the food administration. Waste of meatstuffs was found to be general in some places and in others there was a greater waste of poultry, such as chicken and turkey. Lamb chops and bacon which should have been eaten were also found in the garbage in great amounts.

LEGAL NOTES

A Summary and Notes of Recent Decisions— Rulings of Interest to Municipalities

County Bridges—Commissioners.

Arkansas.—Acts 1915, p. 1346, authorizing organization of assessment districts for raising money to aid county to build bridges, is not objectionable because it authorizes appointment of one set of commissioners by county and another by city council.—*Mullins v. City of Little Rock*, 198 S. W. 262.

Maintenance of Bridge—Weight of Vehicle.

North Carolina.—Correct measure of duty of defendant town was maintenance of bridge of sufficient strength to bear up weight of any vehicle that could reasonably be expected in vicinity where it was placed.—*T. J. Carter & Co. v. Town of Leaksville*, 94 S. E. 6.

Regulation of Automobile Speed.

Wisconsin.—St. 1915, § 1323, relating to riding or driving over bridge faster than a walk, is not applicable to automobiles, and does not give a city power to regulate their speed.—*City of Baraboo v. Dwyer*, 165 N. W. 297.

Bridge Defect—Frightened Horse.

Georgia App.—Where horse became frightened apart from any defect in county bridge, and bystander intercepted it on bridge, causing it to wheel, and fall from bridge, which had no guard rails, county was not liable, as proximate cause was nature of horse and efforts of bystander.—*Corley v. Cobb County*, 93 S. E. 1015.

Property for Public Use—Prior Use.

Minnesota.—Rule that property already devoted to public use cannot be taken for another public use without express authority therefor does not apply to property of a cemetery association not actually put to prior use and not shown to be presently needed therefor.—*In re Board of Water Com'rs of St. Paul*, 165 N. W. 279.

Limitation of Courts—City Appropriating Private Property.

Kansas.—The court cannot sit in judgment upon the motives actuating municipal authorities in appropriating private property for public use.—*De Priest v. Camp*, 168 P. 872.

Laying Out Street—Compensation.

North Carolina.—Abutting owner is not entitled to compensation for laying out street which is absolute necessity for use of his own lot.—*Turner v. North Carolina Public Service Co.*, 93 S. E. 998.

Public Alley—Acceptance by City.

Illinois.—Where alley had been publicly used 25 years, and there had been void attempt by city to vacate it, inference of acceptance by city was justified.—*Rollo v. Pool*, 117 N. E. 756.

Street Dedication—Right of Use Lost.

Washington.—As strip of land claimed to be dedicated as street by platting was never within corporate limits of city, right of use as public highway was lost upon expiration of 5 years without opening, following filing of plat, in view of Laws 1890, p. 603.—*Tamblin v. Crowley*, 168 P. 982.

Live Wire—Negligence.

Missouri App.—Persons have a right to travel on streets even to satisfy curiosity and are not negligent unless it appears positively that they voluntarily and knowingly came in contact with a live wire, or had such knowledge as would put an ordinarily prudent person on inquiry.—*Faris v. Lawrence County Water, Light & Cold Storage Co.*, 198 S. W. 449.

Right of Way—Adverse Use.

Maine.—Twenty years' adverse use is necessary to gain the right to use a private right of way.—*Wooster v. Fiske*, 102 A. 231.

Drainage Districts—Corporate Nature.

(Idaho) Drainage districts are "quasi corporations," being public in their nature and designed to accomplish purposes conducive to the general welfare.—*Burt v. Farmers' Co-op. Irr. Co.*, 168 P. 1078.

Drainage Projects—Details—Engineer's Recommendations.

(Iowa) Details regarding provision for small streams flowing into river proposed to be ditched, and cost thereof, are matters to be worked out in permanent survey of drainage district and improvement.—*Hall v. Polk*, 165 N. W. 119.

Without report and plat of engineer, found by board of supervisors to be disinterested and competent, drainage district may not be established, nor improvement ordered; nor can drainage improvement be constructed otherwise than as recommended by engineer.—*Id.*

Drainage district will not be established to dig ditch to carry off excess surface and river waters, plan being to make ditch undersize, relying on its being enlarged by natural action of water; in absence of showing enlargement is likely to happen within reasonable time.—*Id.*

Drainage Projects—Compensation of Employees.

(Ind.) Under Acts 1885, c. 40, §11, and Acts 1903, c. 232, §1, bond given by petitioners for establishment of drain held for the benefit of the drainage commissioners, rodman, axman, etc.—*State v. Kaukman*, 117 N. E. 643.

Acts 1885, c. 40, §11, does not make county liable for compensation of drainage commissioners and chainmen, rodmen and axmen where proceeding is dismissed and drain never established.—*Id.*

Drainage Improvements—Overflow Damages—Contractors' Negligence.

(Ark.) Contractors constructing drain are liable for injuries for negligent acts done independently for their own private convenience, but not for damages from overflow caused by dam built, according to contract, with skill ordinarily possessed and exercised by contractors doing same or similar work.—*Mitchell v. Hahn*, 198 S. W. 528.

(Ark.) Although contractors are constructing drain under supervision of district engineer they are nevertheless liable for overflow caused by negligence and unskillfulness in building dam.—*Mitchell v. Hahn*, 198 S. W. 528.

Instruction that to find for plaintiff damage must be caused by dam and that damage must have been of such nature that ordinary person could have foreseen and prevented it is not open to objection that it prevents inquiry as to faulty construction in failing to provide adequate spillway.—*Id.*

Flood Prevention District—Constitutionality—Taxation.

(U.S.D.C.) If Ohio Conservancy Act, §12, denies to counties and cities right to object to plan of improvement, held that taxpayer of city and county will suffer no irreparable injury, and may not enjoin the improvement.—*Orr v. Allen*, 245 F. 486.

(U.S.D.C.) Assessments under the Ohio Conservancy Act held made for a public use.—*Orr v. Allen*, 245 F. 486.

Ohio Conservancy Act, §34, providing that appeal from award of compensation or damages or benefits shall be from the award, and from no other part of the decree, held not invalid.—*Id.*

Ohio Conservancy Act, §43, provided for tax on assessed valuation of conservancy district to pay preliminary expenses, held a proper exercise of the power of taxation.—*Id.*

Ohio Conservancy Act, §§46, 47, as to assessment for maintenance of improvement and additional levies to pay principal and interest of bonds, held valid.—*Id.*

(U.S.D.C.) The Ohio Conservancy Act, authorizing the establishment of conservancy districts to prevent floods, etc., is constitutional.—*Orr v. Allen*, 245 F. 486.

NEWS OF THE SOCIETIES

CALENDAR OF MEETINGS.

April 23-24.—LEVEE AND DRAINAGE CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Conference, St. Louis, Mo. Secretary-treasurer, C. S. Gannon, 421 National Bank of Commerce Bldg., St. Louis, Mo.

April 23-26.—SOUTHWESTERN WATER WORKS ASSOCIATION. Seventh annual convention, Tulsa, Okla. Secretary-treasurer, E. L. Fulkerson, Waco, Tex.

April 26, 27.—AMERICAN ACADEMY OF POLITICAL AND SOCIAL SCIENCE. Annual meeting, Philadelphia, Pa. Secretary, J. P. Lichtenberger, University of Pennsylvania, Philadelphia.

May 7-9.—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting, Chicago, Ill. Secretary, Franklin H. Wentworth, 87 Milk St., Boston, Mass.

May 7-10.—CANADIAN GOOD ROADS ASSOCIATION. Annual road congress. Secretary, George A. McNamee, 909 New Birks Bldg., Montreal, Que.

May 13-17.—AMERICAN WATER WORKS ASSOCIATION. Annual convention, St. Louis, Mo. Secretary, J. M. Diven, 47 State street, Troy, N. Y.

May 14.—AMERICAN ASSOCIATION OF ENGINEERS. Fourth annual convention, Chicago, Ill. Secretary, A. H. Krom, 29 South LaSalle St., Chicago.

May 15-22.—NATIONAL CONFERENCE OF SOCIAL WORK. Annual conference, Kansas City, Mo. Secretary, William T. Goss, 315 Plymouth Court, Chicago, Ill.

May 21-23.—ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Annual convention, Hot Springs, Ark.

June 4-6.—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual convention, Chicago, Ill. Secretary, Chief James McFall, Roanoke, Va.

June 4-7.—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting, Worcester, Mass.

June 24-26.—AMERICAN CONCRETE INSTITUTE. Annual meeting, Atlantic City, N. J.

June 25-28.—AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, Atlantic City, N. J. Secretary-treasurer, Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

June 26-28.—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention, Atlantic City, N. J. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

National Electric Light Association.

At a recent meeting of the executive committee of the National Electric Light Association it was decided that a committee of three members should be appointed to co-operate with similar committees of the electric railway and gas industries in the formation of a conference or joint committee to advise in regard to such utility problems of national interest as may be specifically assigned for consideration. This follows consideration of a plan to give specific direction and authority to the work which is being done now by the National Committee on Public Utility Conditions, representing the N. E. L. A., American Electric Railway Association, American Gas Institute and National Commercial Gas Association.

President J. W. Lieb reported at the meeting that the association, in the referendum of the Chamber of Commerce of the United States on water-power development, has given its

affirmative vote for the proposed legislation by Congress. The committee approved the action.

Twenty-seven additional central stations have been admitted as members, also 773 Class B members, 13 Class D members, 76 Class E members and 3 foreign members.

The convention committee of the National Electric Light Association has decided to hold the annual meeting, devoted entirely to war problems, at Atlantic City on June 13 and 14, with the Hotel Traymore as headquarters.

The joint convention of the Pacific Coast Section, N. E. L. A., California Association Electric Contractors and Dealers, and the National Electrical Supply Jobbers' Association of the Pacific Coast will be held at Del Monte, Cal., May 9-11, 1918. This convention had been planned for April 24-27, but was postponed to avoid interference with the Liberty Loan campaign.

Idaho Firemen's Association.

The Idaho Firemen's Association held its recent convention in Pocatello in the council chamber at the city hall. R. W. Burroughs of Jerome is president of the association.

Chief A. B. Canfield of the Pocatello fire department gave a very interesting paper on "Friendship and Co-operation Between Paid and Volunteer Firemen."

Secretary L. B. Redford of Rupert read a paper on "The Benefits to Be Derived From State Organizations."

Warren Compton, assistant chief of the Boise fire department, spoke on "Fire Protection for Schools and Children."

A paper on "The Troubles of a Volunteer Fire Chief" was read by Harry Levy of Gooding and was followed by a paper on "Fire Prevention by Legislation as Well as by Education," by John D. Nimes of Jerome.

A banquet and dance were features of the convention.

Wisconsin Electrical Association.

The convention of the Wisconsin Electrical Association at Milwaukee was held March 27 and 28, and the program included papers dealing generally with rates and rate increases. On the second day all papers except that of M. C. Ewing of Wausau dealt with operating problems.

Daniel W. Mead, consulting engineer, of Madison, discussed "Increasing the Output of Hydroelectric Plants," and divided means into those of "Saving Head" and "Saving Water." Under the former he discussed losses that occur in the headrace due to velocities above 3 feet per second in low-head plants, to racks without specially designed bars, to improperly designed tailraces and to leakages through dams. From the latter cause enough water has been known to escape to cause a loss of \$75,000 a year. He criticised severely the policy of many waterwheel manufacturers who have been in the habit of selling wheels which are considerably underrated.

L. M. Burch, president of the Elec-

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PROBLEMS CITIES ARE STUDYING WITH EXPERTS

Lorain, O., is improving its WATERWORKS. The consulting engineer associated with city engineer C. C. Miller is Morris Knowles.

Ardmore, Ill., is to make STREET IMPROVEMENTS amounting to about \$25,000. The engineer for the work is E. L. Hancock.

A SEWAGE DISPOSAL PLANT to cost \$20,000 is to be built by Rocky River, O. The consulting engineer for the improvement is R. Winthrop Pratt.

A FILTRATION PLANT is to be built by Weston, Ont., from plans drawn by the firm of James, Loudon and Herzberg.

A reinforced concrete BRIDGE is to be built by Lawrence, Mass. Plans and specifications for the structure have been completed by the consulting engineer, B. H. Davis.

Jackson, Ingham, Washtenaw and Hillsdale counties have formed a district to make extensive DRAINAGE IMPROVEMENTS. The engineers for the work are the firm of Zimmer & Zickgraf.

Wolsey, S. D., is to construct WATERWORKS. The engineer for the improvement is W. L. Bruce.

Holderness, N. H., has been considering the construction of a BRIDGE. The selectmen had the consulting services of the Storrs Engineering Co.

A FILTRATION PLANT and DAM are to be built by the village of Cox-sackie, N. Y. The engineer for the improvements is Morrell Vrooman.

Redondo Beach, Cal., is to construct a BREAKWATER. The city has retained the consulting engineering firm of Koebig & Koebig to prepare plans for the project.

A SEWAGE DISPOSAL PLANT is contemplated by Mexico, Mo. The consulting engineering firm of Black & Veatch has prepared plans and specifications for the work.

Hamilton, O., is considering the improvement of its WATERWORKS by the installation of new machinery and extension of distribution system. J. W. Moore, consulting engineer, has submitted a report on the proposals.

INDUSTRIAL NEWS

Cast-Iron Pipe.—A meeting of cast-iron pipe manufacturers was recently held, at which the price situation was thoroughly discussed. While there was a feeling that higher prices ought to be named by the government, it does not seem probable that such action will be taken. The expectation now is that the present schedule will prevail until July 1. The demand from the government for extensions of lines at cantonments continues. Government prices remain constant. Quotations: Chicago, 4-inch, Class B and heavier, \$57.30; 6-inch, \$54.30. New York, 4-inch, Class B and heavier, \$58.35; 6-inch, \$55.35; 3-inch, \$65.35. Birmingham, 4-inch, Class B and heavier, \$52; 6-inch, \$49; Class A, \$1 extra.

The Tiffin Wagon Company, Tiffin, O., has recently issued a new catalog of its street flushing equipment. The different types and sizes of the flushing and sprinkling machines are described in detail with complete specifications. Each kind is shown in illustrations. Machines in service in a number of cities are pictured. The book is excellently gotten up and should be of real interest to street-cleaning officials.

Universal Portland Cement Co., 210 South La Salle street, Chicago, Ill., announces the promotion of J. W. Lowell to the position of division engineer of the company at Pittsburgh, succeeding Mr. Talbot, who has accepted the commission of first lieutenant, Quartermaster's Corps, National Army. He is now stationed at Harrisburg, Pa., where he is engaged in work on the new Quartermaster's Depot.

Purchasing Agents Want Standard Size Catalogs.

A conference has been called by the catalog committee of the National Association of Purchasing Agents at which it is proposed to determine upon a standard size for catalogs. The conference will be held on May 22 at the Hotel La Salle, Chicago. W. L. Chandler, Dodge Sales & Engineering Co., Mishawaka, Ind., is chairman of the catalog committee. At the Pittsburgh convention of purchasing agents the size 8½ x 11 in. was tentatively adopted. The committee has had the matter up with 575 associations, representing various industries and trades, and 287 trade paper publishers. Quite a difference of opinion as to the best standard size is reported.

It is claimed that the size 7½x10½ in. is a logical one to produce from a sheet 32x44 in., running 16 pages. The size 8½x11 in. has already been adopted by the American Institute of Architects as its standard and that a great many manufacturers are issuing catalogs on the basis of that standard. Other associations, notably the gas interests, have been working on this same proposition and have adopted

other standards. The desirability of having catalogs the same size of letter-head is also being considered. In this connection it is claimed that the size 8½x11 in. for a letterhead is not the most desirable size—that very few letters utilize the full sheet and that in the absence of the half size letter-heads, which at one time were used, a great deal of paper is now wasted—that for somewhat the same reasons as apply to catalogs the size of letter-heads should be 7½x10½ in. The catalog conference will be an open one.

The Brown Hoisting Machinery Co., Cleveland, O., has issued a new catalog, "E," describing its line of Brownhoist buckets and tubs. Among the equipment presented and illustrated are the excavating grab buckets, single rope grab buckets, contractors' grab buckets, drag line buckets and tubs. Specifications, tables of sizes and diagrams are included.

PERSONALS

Rudolph Blankenburg, ex-mayor of Philadelphia, died in his home there, April 12, after a short illness, in his seventy-sixth year.

For more than thirty years Rudolph Blankenburg was connected with reform politics in Philadelphia, and twenty-five years after he began his fight for decent government in that city he was elected mayor. His election in 1911 was the climax of one of the greatest reform campaigns ever fought in this country. At the end of a year he had overthrown the "contracting gangs," had driven out graft in the city departments, and had cleaned up the city government as far as was possible, with an antagonistic city council. He developed a thoroughly independent, highly trained, fully equipped police and fire-fighting force, thoroughly rearranged the taxation system, established a regular budget system for all departments, and placed them all on a business basis.

Rudolph Blankenburg was born in Germany in 1843. His father was the pastor of the chief church of the town. He had at first a private tutor, and then attended a gymnasium, where his studies were planned with a view to his entering the ministry. In 1865, at the close of the Civil War, young Blankenburg, then twenty-two years of age, came to this country, entered mercantile business as clerk, and after eleven years went into business for himself, retiring in 1909.

It was at the time of the Centennial Exposition in Philadelphia, in 1876, that Mr. Blankenburg began to be active in reform politics and civic improvements. He, with others, at this time detected a warning note in the wastefulness of charities in Philadelphia, and in 1877 the Society for Organizing Charities was formed.

Mr. Blankenburg, in the days of the famous Gas Trust, was a member of

the Committee of One Hundred, which in 1881 was organized to deal with the corrupt measures of the political faction which was at that time making the city of Philadelphia a hotbed of graft.

In 1905 Mr. Blankenburg was importuned to take office for the first time, and was nominated by the City party as city commissioner. He was elected and for the next three years served in that office, returning to the city his salary of \$5,000 a year. This he paid not to the city treasury, because he suspected the mismanagement of the city's finances, but to the Board of City Trusts, specifying that the income should be equally divided between the pension fund of the police, firemen and school teachers.

After his retirement from office he continued his civic interests. He was very active in the formation of the Town Meeting part last year, after the shooting scandals in the primary elections.

The following mayors have been elected in Maine:

Bath, Edward J. Drake.
Eastport, Fred T. Eldredge.
Hallowell, John M. Robinson.
Lewiston, Charles P. Lemaire.
Rockland, Frank C. Flint.
Saco, Edgar L. Minot.
South Portland, Charles E. West.
Waterville, Everett C. Wardwell.
Ellsworth, Alexander G. Hagerthy.
Bangor, John F. Woodman.
Belfast, Clement W. Westcott.
Biddeford, Hartley P. Banks.
Brewer, Charles W. Curtis.

NEWS OF THE SOCIETIES

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trical Supply Company, Madison, discussed the aims and purposes of the new association of Wisconsin electrical contractors and dealers.

George E. Wagner, superintendent of plant for the Madison Gas & Electric Company of Madison, Wis., pointed out the advantages of three-phase, four-wire distribution as compared with the ordinary 2,300-volt delta-connected system.

M. C. Ewing, secretary-treasurer of the Wisconsin Valley Electric Company, Wausau, Wis., in a paper entitled the "Utilities and the War," emphasized the great need for rate increases and closer study of labor conditions.

"Metal Electrode Welding" was treated by Dean Treat, manager of the Wisconsin Railway, Light & Power Company, La Crosse, Wis.

Officers elected for the coming year were: President, John St. John, Madison; first vice-president, Raymond Smith, Oshkosh; second vice-president, W. C. Lounsberry, Superior; third vice-president, A. G. Babson, Watertown; secretary, J. P. Pulliam, Green Bay.